The acquisition of verb compounding in Mandarin Chinese

Chen, J.

2008

INTRODUCTION

CHAPTER 1

1.1 The aim of this study

Language acquisition researchers have long been interested in how children learn the partially productive constructions of a language, for example, patterns of word formation (Clark, 1993) and argument structure alternations (e.g., Bowerman, 1988c; Pinker, 1989; Tomasello, 1992). Learning such constructions can be seen as instances of a more general problem of how language learners make generalizations and avoid overgeneralizations. In acquiring the principles governing such constructions, the child must discover how to unpack the relevant information – to isolate the components within a combination and identify their contribution to the meaning of the whole, and to discover the regularities in how the forms and their meanings are combined (Bowerman, 1982a; Clark, 1993; Pinker, 1989; Tomasello, 1992). This learning process is complicated by the fact that children start out not knowing which meaning–form mappings are conventional within the language, and which are innovative (Clark, 1993). Given that little negative evidence and formal instruction are usually available in the input, a basic question arises – how do normally developing children eventually acquire their first language successfully?

To answer this broadly framed question, the study of verbs can serve as a key to the "black box" of language acquisition. Verbs are central in our daily descriptions of objects and events. They are associated with morphosyntactic properties such as word morphology and argument structure. They can combine with other linguistic elements such as prefixes, suffixes, particles, adjectival phrases, and prepositions. Recent research has drawn attention to striking variation across languages in the semantic information encoded in the verbs used for similar types of events. The existence of crosslinguistic variation means that children have to discover the conventions for mapping meanings onto grammatical verb forms in the language they are learning. In particular, they have to learn language-specific constructions for forming new words and phrases, for example, how to combine verbs with particles in English, e.g., *break off* for breaking a branch, versus how to combine two verbs in Mandarin,[1] e.g., *zhe2-duan4* 'bend-be.broken', for the same event.

This dissertation investigates the acquisition of verb compounding, a grammatical construction that is very productive in Mandarin. I examine the semantic and syntactic development of verb compounding to determine how Mandarin-speaking children learn the linguistic representation of events of motion and state change. In particular, I focus on children's production and comprehension of two major types of verb compounds: Directional Verb Compounds (DVCs), e.g., *la1-chu14* 'pull-exit', as in (1a), and Resultative Verb Compounds (RVCs), e.g., *xi3-gan1jing4* 'wash-be.clean', as in (1b). These two types of verb compounds represent the most typical way to encode events of motion and state change in Mandarin.

(1) a. *Zhang1san1* **la1-chu1** *le* *zhuo1zi.* (DVC)
Zhangsan pull-exit PFV table
'Zhangsan pulled out the table.'
b. *Zhang1san1* ***xi3-gan1jing4*** *le* *yi1fu.* (RVC)
Zhangsan wash-be.clean PFV clothes
'Zhangsan washed the clothes clean.'

As shown in the examples in (1), DVCs and RVCs involve the combination of verbs (including adjectival verbs, as in (1b)). These forms express meanings that are typically encoded in English with verb-particle combinations, like *pull out* and *wash clean.*

DVCs and RVCs are very productive in Mandarin, and can be created on the spot to describe an event of motion or state change. Take the event of washing clothes, for example. Mandarin speakers can use the conventional RVC *xi1-gan1jing4* 'wash-be.clean' if the clothes turn out clean after the washing, or they can create the new but perfectly acceptable RVC *xi3-zang1* 'wash-be.dirty' or *xi3-po4* 'wash-be.torn' if the clothes turn out dirty or torn. In other words, Mandarin allows the combination of 'wash', which implies a result state of becoming clean, with a complement verb that conflicts with this implied result (e.g., 'be.dirty') or that has nothing to do with cleanliness (e.g., 'be.torn'). Combinations like these

[1] "Mandarin" is used for Mandarin Chinese throughout this dissertation.

are not allowed in languages such as English and Japanese (Bowerman, 1988b; Uehara, Li, & Thepkanjana, 2001), even though their structure would be fully comparable to those of acceptable constructions such as *wash the clothes clean.*

Verb compounding has been regarded as either a morphological process of creating complex verbs or a syntactic process. Mandarin verb compounds are given lexical status in the two classical descriptive works on Mandarin. Chao (1968) defined them as a combination of two or more root words bound together to form a single verb, and Li & Thompson (1981) described them as polysyllabic units that have certain properties of single words and can be analyzed into two or more meaningful elements or morphemes. Verb compounds have also been regarded as a subtype of serial verb constructions, which have been defined as instances of a succession of verbs with a single subject and a single tense value (Collins, 1997). In this dissertation I will follow Construction Grammar theory (e.g., Brugman, 1988; Fillmore, Kay, & O'Connor, 1988; Goldberg, 1995), and treat verb compounds as instances of grammatical constructions. Constructions can represent any combination of lexical, syntactic, morphological, and prosodic patterns. They integrate form and meaning in conventionalized and often non-compositional ways. Mandarin verb compounds can be composed not only of verbs, as in *qie1-duan4* 'cut-break',[2] but also of forms that in other contexts are adjectives, such as *hong2* 'red' in *ran3-hong2* 'dye-red', since Mandarin adjectives can also function directly as predicates (i.e., they do not take a copula verb as in English) (Chao, 1968). Verb compounds can also be composed entirely of nouns, e.g., *wu4-se4* 'object-color' (hunt for), and *zuo3-you4* 'left-right' (influence, affect), or of a verb and a noun, e.g., *chu1-chai1* 'exit-errand' (go on a business trip), and *fang4-xin1* 'put-mind' (relax)[3]. As illustrated by these examples, the meaning of a verb compound is not necessarily compositional – it does not always transparently reflect the meaning of its components. Although Mandarin has many types of verb compounding constructions, in this dissertation I will focus on two particular types: directional verb compounds and resultative verb compounds.

Productivity in language acquisition is defined as children's ability to go beyond what they have heard in the input to produce novel but appropriate utterances. To learn to use verb compounds productively, children have to analyze the compounds they have heard in the input into their components. But this is just the first step. As shown by the examples in (1), a

[2] The glosses given to the compounds are not precise, since English often does not have exact semantic counterparts to the component verbs. I will discuss the semantics of the component verbs in later chapters of this dissertation.

[3] See Packard (2000) for detailed discussion of the subtypes of Mandarin VCs and their status as words or phrases. In this study, I focus only on verb compounds that are composed of verbs.

DVC or an RVC is not formed by random combinations of verbs; rather, combinations are rule-governed. For instance, the process is constrained by how the component verbs are ordered. Verbs of different semantic classes occur in different slots of a compound, for example, *chu1-la1* 'exit-pull' or *gan1jing4-xi3* 'be.clean-wash' are not acceptable. The creation of verb compounds is also constrained by which verbs can be combined. For instance, native speakers of Mandarin reject the RVC **la1-zuo4* 'pull-sit' as a description of an event of causing someone to sit down by pulling on him (see Chapter 2).

DVCs and RVCs constitute a Mandarin-specific way of lexicalizing events that has implications for fundamental issues in both theoretical linguistics and language acquisition. From a linguistic perspective, the study of DVCs and RVCs can deepen our crosslinguistic understanding of: (1) the productivity of grammatical patterns (in particular, the phenomenon of constrained productivity), (2) the semantic typology of event representation (in particular, the representation of motion events and state-change events), (3) event categorization (in particular, universal versus language-specific categories of events), and (4) argument mapping (i.e., how the arguments of a complex predicate are realized). These issues permeate many of the questions that students of language acquisition raise about children's learning process. For example, how do language learners become productive with the grammatical constructions of their language? How do they learn the specific semantic organization of their language? How do they construct the event categories that are conventionally label by words in their language? And how do they discover the correct argument mapping?

Verb compounding is highly productive in Mandarin, and it has attracted much attention in Chinese linguistics. Theoretical issues include, for example, the formation of RVCs and DVCs and their lexical properties (e.g., Chao, 1968; C. Li & Thompson, 1981; F.-X. Li, 1993; Lu, 1977), head features of compounds and the argument structure of RVCs (e.g., Cheng & Huang, 1995; Gu, 1992; Huang, 2006; Y.-F. Li, 1990; Shen, 1993), argument structure alternation patterns of RVCs (e.g., Cheng & Huang, 1995; D.-Y. Li, 2003; Y.-F. Li, 1990, 1995), and aspectual features of RVCs and DVCs (Cheng & Huang, 1995; Kang, 1999, 2001; Y.-F. Li, 1990; Shen, 1993). Controversies still remain about many aspects of the structure and derivation of verb compounds. But despite their prominence in Chinese linguistics, little systematic work has been done on their acquisition. Since motion and state change are basic event types that every child encounters early in life, the study of the development of DVCs and RVCs will reveal early developments in the linguistic construal of events by children.

In this dissertation I focus on acquisition by zooming in on the learning of specific kinds of verb compounding in Mandarin. In doing so, I hope to bring a crosslinguistic perspective to the fundamental issue of productivity in first language acquisition. I will investigate several closely related questions:

(i) When do children begin to use verb compounds productively, and when do they learn the semantic constraints on combining verbs to form new verb compounds?

(ii) How do children understand the meaning of verb compounds? In particular, how do they learn the schematic constructional meaning of the compound as a whole, as well as the semantic division of labor between the component verbs? For example, which of the two (or more) verbs establishes the state-change meaning of a resultative verb compound, and how do the fine-grained meanings of the component verbs work together to convey a complex state-change meaning?

(iii) How do children learn the argument structure of verb compounds?

More generally, the aim of this study is to map out the course of development in children's production of DVCs and RVCs, and to explore the learning problems they encounter in producing and comprehending these constructions. By examining the questions I have outlined, I hope to shed light not only on how first-language learners acquire complex predicates with complex semantics and syntax, but also how language learning is influenced by the language-specific lexicalization of events of motion and state change. This study will then have significance for both the study of language acquisition and the study of cognition and event construal.

1.2 Organization of the dissertation

The dissertation consists of eight chapters and is divided into a theoretical part (Chapters 1 to 3), an empirical part (Chapters 4 to 7), and conclusions (Chapter 8).

The present chapter has outlined the aim and rationale of this study, explained what the general research questions are, and introduced the target constructions to be investigated.

Chapter 2 is devoted to a description of the linguistic properties of Mandarin DVCs and RVCs. It discusses typological features of the way Mandarin lexicalizes motion events and state-change events. The semantic typology of the lexicalization of motion and state change is relevant since DVCs and RVCs represent the typical predicates used in Mandarin to encode these types of events. This chapter describes in detail the constructional properties of DVCs and RVCs, including their composition, semantic and syntactic properties, and constraints on their productivity.

Chapter 3 discusses theoretical issues to do with productivity in language acquisition, and presents a review of relevant studies of the acquisition of the complex predicates that encode motion and state-change events. These discussions provide the general theoretical framework and the empirical grounding for my own empirical studies of the acquisition of verb compounding. In these studies I have both analyzed longitudinal spontaneous speech data (two corpora) and collected new experimental data on production, comprehension, event categorization, and argument mapping. These studies are presented in the subsequent chapters.

Chapter 4 reports analyses of two longitudinal spontaneous speech corpora and three experiments on the development of the production of DVCs and RVCs. The speech corpora are the Beijing Mandarin corpus in CHILDES (CHIld Language Data Exchange System) (MacWhinney, 2000; Tardif, 1993, 1996) and the Fang Corpus (Min, 1994).[4] Both corpora contain *pinyin*[5] transcriptions of the longitudinally-sampled natural speech of the target children and their family members and caregivers. The *pinyin* transcriptions are in a format compatible with CHAT (i.e., Codes for the Human Analysis of Transcripts), the standard transcription system for CHILDES. I studied two corpora of spontaneous speech rather than only one for two reasons: (1) to be able to generalize findings more confidently, and (2) to compensate for the gaps in the data from either of the corpora taken alone. The CHILDES Beijing Mandarin corpus contains data from 10 children between the mean ages of 1;9 and 2;2.[6] The Fang corpus covers five children over a wider age range, 0;11 to 3;5. Of the three experimental studies, two are elicited descriptions of different sets of video clips: Experiment 1, the *Tomato Man* elicitation, and Experiment 2, the *Kids' Cut and Break* elicitation, provide focused data on DVCs and RVCs respectively. Experiment 3, the *VC Constraints* study, addresses children's knowledge of semantic constraints on creating VCs.

---

[4] The Fang corpus was collected by Ruifang Min in Beijing under the supervision and guidance of Prof. Zhen-Yuan Xu of Beijing University. The naming of the corpora is mine, after the first name of the principal data collector Ruifang Min. I am very grateful to both researchers for their generous permission to use their data. I also thank Wolfgang Klein for helping me get in contact with Min, and Romuald Skiba for technical ingenuity and patience in retrieving these data from an outdated format.

[5] Pinyin is the official system used in P. R. China to transcribe Mandarin into the Roman alphabet.

[6] Age is represented in years;months or years;months.days.

Chapters 5 and 6 investigate children's grasp of the semantics of VCs from two different perspectives. Chapter 5 examines children's understanding of the schematic constructional meaning of RVCs as a whole, and of the semantic division of labor between the component verbs, including in particular where in the compound the meaning of state change is expressed. To investigate this issue, I conducted Experiment 4, the *State-change* experiment. Chapter 6 presents a study of the learning of the fine-grained meanings of the component verbs of VCs elicited in Experiment 2 to describe "cutting and breaking" events. The focus here is on the categorizing and encoding of events.

Chapter 7 investigates children's knowledge of the argument structures of a subset of RVCs: transitive RVCs with varied argument assignment patterns. To explore children's interpretation of which semantic functions map to which syntactic positions, I conducted Experiment 5, the *Argument Structure Cartoon study*.

Chapter 8 summarizes the findings of the preceding chapters and discusses what we have learned from all the studies.

LEXICAL AND SEMANTIC PROPERTIES OF MANDARIN VERB COMPOUNDS

CHAPTER 2

2.1 Introduction

This chapter discusses typological features of the encoding – or lexicalization – of motion events and state-changes events in Mandarin, as represented by the pervasive use of DVCs and RVCs. Lexicalization refers to the systematic association of particular components of meaning with particular morphemes or constructions (Talmy, 1985, 2000). Languages vary in how they express the semantic components of an event. Crosslinguistic variation has been well studied in the semantic domain of events associated with change of location (i.e., motion events) and change of state. Sections 2.2 and 2.3 discuss the semantic typology of the lexicalization of motion and state change. Section 2.4 distinguishes VCs from other serial verb constructions. Sections 2.5 and 2.6 present the compositional, lexical, and semantic properties of DVCs and RVCs that we need to know in order to understand how these compounds are acquired. Although DVCs and RVCs encode different types of events, they share very similar surface forms – two or three verbs are combined according to a formal constructional template, $V_1V_2(V_3)$, which can be used to encode both spontaneous and caused events of motion and state change. But the two types of constructions differ in the semantic classes of verbs that can appear in the slots of the template. Section 2.7 discusses productive patterns of compounding verbs to create well-formed DVCs and RVCs. Finally, §2.8 proposes a number of constraints on the compounding process.

2.2 Encoding motion events

A motion event can be defined as a situation involving the movement of an entity or the maintenance of an entity at a stationary location (Talmy, 1985, p. 60). By "movement" is meant a “directed” or “translative” motion that results in a change of location. By “location” is meant either a static situation of being in a place or a “contained” motion that results in no overall change of location (e.g., jumping up and down). A basic motion event consists of one object moving or located with respect to another object. It is analyzed as having four basic semantic components: *Motion, Figure, Ground,* and *Path* (Talmy, 1985, 2000). These are illustrated in (2):

(2)	The pencil	rolled	off	of	the table.
	[Figure]	[Motion]	[Path]		[Ground]

The Figure is the entity whose location is at issue. The Motion component represents the fact of motion or location maintenance. The Ground is the entity with respect to which the Figure moves or is located (i.e., the referent object), and the Path is the trajectory followed (or the position maintained) by the Figure with respect to the Ground.

Path is the core event of a motion event, since without Path there is no motion. Talmy observes that languages differ systematically with respect to the lexical elements that are used to encode information about Path. He proposes a two-way semantic typology of the lexicalization of motion on the basis of where languages characteristically express Path (Talmy, 1991, 2000). In “satellite-framed” languages (e.g., English), Path is typically expressed in a “satellite” to the verb – a member of a grammatical category of constituents other than a noun phrase or a prepositional phrase that is in a sister relation to the verb root. English verb particles such as *in, out,* and *across* are typical examples of Path satellites. In “verb-framed” languages (e.g., Spanish, Korean), Path is characteristically encoded in the main verb of the clause, an element with a meaning along the lines of ‘enter, exit, ascend, descend, insert, extract’, and so on.

Talmy observes that satellite-framed languages and verb-framed languages differ in their characteristic encoding not only of Path information, but also of information about the *Manner* or *Cause* of the motion event – events that are associated with and support the core event of motion (Talmy, 2000). Manner refers to the way in which the Figure moves and Cause to the event that causes it to move.[7] In satellite-framed languages, Manner or Cause is typically encoded in the main verb, which also expresses motion, as illustrated in (3).

[7]According to Talmy (1985, 2000), the assessment of whether it is Manner or Cause that is expressed in the verb is based on whether the verb basically refers to what the Figure does or what the agent or an instrument does.

(3) a. The ball rolled off of the table.
Roll: [Motion + Manner]
b. The ball blew off of the table.
Blow: [Motion + Cause]

In (3a), Motion is "conflated" (combined) with Manner, with the verb *roll* meaning roughly "move while rolling". In (3b), Motion is conflated with Cause, with the verb *blow* specifying both that the ball moves and that the cause is air blowing on it.

Verb-framed languages such as Spanish typically express Manner or Cause in a clause or other constituent separate from the main clause, e.g., the adverbial shown in the Spanish example in (4).

(4) El	hombre	**entró**	a	la	casa	**corriendo.**
The	man	entered	to	the	house	running

'The man ran into the house.'

In (4), the main verb, *entró*, indicates that motion occurs along a particular Path, with no indication of Manner; the "supporting information" about the Manner of movement is conveyed by the present participle *corriendo* 'running'.

In his typology of the expression of motion events, Talmy classifies Mandarin as a satellite-framed language like English on the basis of his analysis of DVCs in examples like (5).

(5) a.

Na4	*ge*	*ren2*	***pao3-jin4***	*le*	*fang2zi.*
That	CLF	person	run-enter	PFV	house

'That person ran into the house.'

b.

Na4	*ge*	*ren2*	*ba3*	*zhuo1zi*	***tui1-chu1***	*le*	*dong4.*[8]
That	CLF	person	BA	table	push-exit	PFV	cave

'That person pushed the table out of the cave.'

For example, in (3a), *roll* refers to what the ball does (it rotates while moving), so it expresses the Manner, whereas in (3b), *blow* refers what the agent (someone or some natural force) does, so it expresses the Cause of the event.

[8] The morpheme *ba3* marks the well-known BA construction of Mandarin. This construction is known as the "disposal construction" (Chao, 1968; C. Li & Thompson, 1981; Wang, 1954), since it focuses on how the object is disposed of, dealt with, manipulated, or handled by the subject. The morpheme *ba3* originally meant 'dispose, manipulate, hold' in classical Chinese, but it has become grammaticalized and lost this meaning. The status of *ba3* is controversial: it has been argued to be a focus marker (Sun & Givón, 1985), a secondary topic marker (Tsao, 1996), or case assigner (Huang, 1982).

These sentences each contain a DVC, *pao3-jin4* ‘run-enter’ in (5a) and *tui1-chu1* ‘push-exit’ in (5b). Talmy treats the first verb of these DVCs as the main verb, encoding the Manner (‘run’) and the Cause (‘push’) of the motions, respectively. He treats the second verb as a Path satellite – *jin4* ‘enter’ and *chu1* ‘exit’. Talmy argues that Mandarin Path verbs are satellites because they often do not function as full verbs and form a small closed set.

But characterizing Mandarin as a satellite-framed language does not precisely capture the nature of the lexicalization of motion events in Mandarin. Slobin (2004) points out that Mandarin and other serial-verb languages differ from satellite-frame languages in that the so-called satellites, unlike English particles or Russian verb prefixes, are full verbs that can be used as predicates directly. This is illustrated in (6):

(6) *Ta1* ***jin4*** *le* *fang2zi.*
He enter PFV house
‘He entered the house.’

In (6) the verb *jin4* ‘enter’ encodes the Path component of this motion event. Sentences like (6) show the pattern characteristic of verb-framed languages, whereby the Path component of the event is conflated with the motion component. In the literature, many linguists treat the second element of a directional verb compound as a verb (Kang, 2001; Y.-F. Li, 1990; Lu, 1977; Zou, 1994), and some linguists treat it as a category intermediate between verb and particle, e.g., “postverb” (McDonald, 1995).

Although Mandarin does not pattern with satellite-framed languages, it also does not pattern with verb-framed languages such as Spanish, since there is no distinction between finite and nonfinite forms as there is in typical verb-framed constructions such as ‘exit flying’. Slobin therefore proposes a revision of Talmy’s binary distinction, adding a third category, “equipollently-framed languages” (Slobin, 2004). In this pattern, Path and Manner are expressed by equivalent grammatical forms. Mandarin and other serial-verb languages are examples of this third type of languages.

Slobin’s proposal is supported by a recent empirical study of the encoding of motion events in Mandarin and its acquisition (although see Peyraube, 2006, for a counterargument). L. Chen (2005) analyzed both written text corpora of modern Mandarin novels and elicited oral descriptions of the *Frog Story*[9] elicited from native speakers of Mandarin (ages 3, 4, 5, 9, and adults). Comparing the structural and discourse patterns of the descriptions of motion events in frog stories in Mandarin with those in English, and Spanish, he found that Mandarin speakers use a mixed pattern with features of both the satellite-framed and the verb-framed patterns. For example, like English speakers, Mandarin speakers use a large set of verbs of Manner of motion. But like Spanish speakers, they often describe the physical settings of motion events from which this information can be deduced, and only rarely provide elaborate ground descriptions. L. Chen (2005) concluded that, as Slobin has proposed, Mandarin should be treated as an equipollently-framed language, distinct from either satellite-framed languages or verb-framed languages.

2.3 Encoding state-change events

A state-change event in Talmy's system consists of a change in, or – in the limiting case – the unchanging continuation of a certain property associated with a particular object or situation (Talmy, 2000). Linguistic representations of these situations include *The door swung shut* (change) and *The door is shut* (stasis). Talmy observes that the way state change is expressed is analogous to the way motion is expressed. Change or stasis with respect to a state parallels motion or stationariness with respect to a ground object, and state transition type parallels Path type. For example, the entity that undergoes a state change is often presented as a Figure that (metaphorically) moves to a state specified by a satellite or other verb complement, e.g., *She entered (a state of) ill health, She became ill* (the static counterparts of these are expressions like *She is in ill health*) (Talmy, 2000, p. 238). Talmy suggests that this conceptual analogy motivates a syntactic and lexical analogy: to a great extent, state change is expressed in a language by the same constituent type as Path, and often by homophonous forms. Thus, in accordance with the general typology, the core schema of an event of state change appears in a satellite in satellite-framed languages, and in the main verb in verb-framed languages. For example, in the satellite-framed English construction *The door swung/creaked/slammed shut*, the state change is represented by the adjectival complement *shut* (i.e., a satellite), whereas the Manner in which the state change takes place is represented by the main verb. Similarly in *He choked to death on a bone*, the state change 'die' is

[9] Mayer's (1969) wordless picture book "*Frog, where are you?*", which tells a story about a boy and his dog searching for their runaway pet frog, has been widely used to elicit standardized narratives from speakers of different languages and different ages. These narratives are called "frog stories," and the research method is now commonly known as the *frog story* method (Berman & Slobin, 1994).

represented by the satellite *to death,* while the causal event is represented in the main verb *choke*. In verb-framed languages like Spanish, in contrast, the state change 'die' is expressed in the main verb, while the Manner or Cause is encoded in an adverbial phrase, as in *Murió atragantado por un hueso* 'he died choked by a bone'.

The conceptual analogy between motion events and state-change events is borne out in Mandarin. RVCs, the typical way to encode state-change events, resemble DVCs in structure: the cause component is represented by the first verb of the compound, analogous to the cause/manner verb of a DVC, and the state-change component is represented by the second verb, analogous to the Path verb (the second verb) of a DVC. For example:

(7) a. Nonagentive

Ta1 ***ka3-si3*** *zai4 yi2 kuai4 gu3tou2 shang4.*

He choke-die at one CLF bone on

'He choked to death on a bone.'

b. Agentive

Wo3 ***shao1-si3*** *le ta1.*

I burn-die PFV him

'I burned him to death.'

The cause is encoded in the first verb in ***ka3****-si3* 'choke-die' in (7a) and ***shao1****-si3* 'burn-die' in (7b), and the state change in the second verb, *si3* 'die'. Both spontaneous and caused state changes can be encoded with an RVC. The combination of a verb denoting a cause and a verb denoting a result state is very productive in Mandarin.

Talmy (2000) suggests that in the domain of state change, English exhibits a mixed system of conflation characteristic of both the satellite-framed pattern and the verb-framed pattern, and both patterns are colloquial. For example, the verb-framed pattern is seen in many monomorphemic state-change verbs that encode state change directly, such as *break* in *He broke the door (by kicking it).* Talmy treats Mandarin as a "far more a thoroughgoing examplar of the satellite-framed type" (Talmy, 2000: 241), since state change is consistently encoded in the satellite. What Talmy calls satellites are the complement (i.e., second) verbs of RVCs, such as *po4* 'be.broken' in *ti1-po4* 'kick-be.broken'.

As discussed in §2.2, it is still controversial whether Mandarin should be treated as a satellite-framed language in the domain of motion, given that the complement verbs of DVCs have full verb status. This debate also applies to the domain of state change, where the component verbs of RVCs can also be used as full verbs; e.g., *po4* 'be.broken' in *bei1zi po4 le* 'the cup broke'. Since there is no morphological marking of finiteness in Mandarin, either of the component verbs of an RVC can logically be argued to be the core event-framing verb. This debate is reflected in the literature on various studies of the headness of Mandarin verb compounds (Cheng & Huang, 1995; Gu, 1992; Huang, 2006; e.g., Y.-F. Li, 1990; Shen, 1993).

To summarize, DVCs and RVCs play an important role in the Mandarin style of lexicalizing the semantic components of motion and state-change events, and Mandarin children must become productive with these constructions. In what follows, I describe the compositional and lexical semantic properties of Mandarin DVCs and RVCs in more detail. I start out by first clearly distinguishing verb compounds from other serial verb constructions. I then describe their compositional and lexical semantic properties.

2.4 Distinguishing VCs from other serial verb constructions

I will use the term *serial verb construction* to refer to serial verb constructions other than verb compounds. An example of a serial verb construction is given in (8):

(8) *Wo3 qi2 che1 qu4 shu1dian4 mai3 hui2 na4 ben3 shu1 hui2 jia1 zi3xi4 kan4.*

I ride bicycle go bookshop buy return that CLF book return home carefully read

'I cycled to the bookshop, bought that book, returned home, and read it carefully.'

In this example, there are five VPs lined up one after another: *qi2*, 'ride', *qu4* 'go', *mai3* 'buy', *hui2* 'return', and *kan4* 'read'. Among these verbs, only *mai3* 'buy' and *hui2* 'return' form a verb compound, *mai3-hui2* 'buy-return'. It can be singled out on the basis of the following considerations.

Prosodically, a verb compound is a single-stress unit (Chao 1968). This means that in a verb compound only simplex verbs are combined, and there can be no intervening NP, as shown by the ungrammaticality of (9b) (compare to (9a)). An aspect marker normally follows the whole compound (compare (10a) with (10b)).

(9) a. *Zhang1san1 zuo2tian1* ***da3-po4*** *le bei1zi.*

Zhangsan yesterday **hit-be.broken** PFV cup

'Zhangsan broke the cup yesterday.'

b. * *Zhang1san1 zuo2tian1* ***da3*** *bei1zi* ***po4*** *le.*

Zhangsan yesterday hit cup be.broken PFV

'Zhangsan broke the cup yesterday.'

(10) a. *Wo3* ***han3-ya3*** *le sang3zi*.

I **shout-hoarse** PFV throat

'I shouted my throat hoarse.'

b. * *Wo3* ***han3*** *le* ***ya3*** *sang3zi.*

I shout PFV hoarse throat

'I shouted my throat hoarse.'

Syntactically, verb compounds involve two (maximally three) verbs, with a surface form $V_1V_2(V_3)$. In contrast, a serial verb construction can be represented schematically as *NP AUX [V (NP) V (NP) V (NP)…]*, and it allows the concatenation of VPs (V + NP), as illustrated above in (8). It does not restrict the number of verb phrases that can be combined, as long as the sequence of the verbs mirrors the order of the real-world event, as in (11).

(11) *Zhang1san1 gong1zuo4 zheng4 qian2 mai3 fang2zi qu4 xi2fu2.*

Zhangsan work earn money buy house marry wife

'Zhangsan works to earn money to buy a house, and to marry a woman.'

Serial verb constructions very often involve a sequence of VPs rather than combinations of single verbs. Verb compounds, on the other hand, are composed of simplex verbs, not VPs.

The semantic relations between the components of a serial verb construction and the components of a compound verb also differ. In serial verb constructions, the events depicted by different V(P)s may be understood to be related in one or more of the following ways (Li & Thompson, 1981):

(12) a. Consecutive: one event occurs after the other:

Wo3men2 mai3 piao4 jin4-qu4.

We buy ticket enter-go

'We bought tickets and entered.'

b. Purpose: the first event is done for the purpose of achieving the second:

Wo3men2 kai1 hui4 tao3lun4 na4 ge wen4ti2.

We hold meeting discuss that CLF problem

'We hold a meeting to discuss that issue.'

c. Alternating: the subject of the predicates alternates (e.g., *wo3men2* 'we', alternates between 'be careful' and 'not to get sick'):

Wo3men2 ying1gai1 xiao3xin1 bu4 sheng1 bing4.
We should be.careful not get sick
'We should be careful not to get sick.'

d. Circumstance: the first verb phrase describes the circumstances under which the event specified by the second verb phrase or clause occurs:

Wo3 yi1 ge ren2 wan3shang4 chu-qu4 hen3 hai4pa4.
I one CLF person night exit-go very scare
'I am very scared of going out alone at night.'

Structurally, one verb phrase or clause often serves as the subject or direct object of another verb in a serial verb construction. For example, in (13a) the second verb phrase/clause is the direct object of the first verb, and in (13b) the first verb phrase/clause is the subject of the second verb.

(13) a. *Ta1 fou3ren4 ta1 zuo4 cuo4 le.*
He deny he do wrong PFV
'He denies that he was wrong.'
b. *Da3 sheng1 nian4 ke4wen2 ke3yi3 bang1zhu4 fa1yin1.*
Big voice read text can help pronunciation
'Reading the lesson aloud can help one's pronunciation.'

A major subtype of serial verb constructions is the so-called pivotal construction, in which an NP is simultaneously the direct object of the first verb and the subject of the second verb, as in (14) and (15).

(14) *Wo3 quan4 ta1 xue2 yi1.*
I persuade him study medicine
'I persuade him to study medicine.'

(15) *Ta1 you3 yi1 ge mei4mei4 hen3 xi3huan1 kan4 dian4ying3.*
He has one CLF sister very like watch movies
'He has a sister, who likes watching movies very much.'

Sentences (14) and (15) have no grammatical marking to indicate the relationship between the first VP and the second VP. In contrast, their English counterparts use an infinitive and a relative clause, respectively.

In VCs, three major types of semantic relations hold between the component verbs or the event types specified by the compound: (a) synonymous verb compounds (Packard, 2000) (also called parallel VCs in Li & Thompson, 1981), such as *dao4-qie4* 'steal-steal' (steal) and *bao3-wei4* 'protect-guard', in which the two verbs are synonymous; (b) directional verb compounds (DVCs), such as *zou3-chu1* 'walk-exit', and (c) resultative verb compounds (RVCs), such as *ti1-po4* 'kick-break'.[10] Parallel VCs occur mostly in written texts. I have excluded this type of verb compounds from the current study as they are relatively rare in the input to young children. I focus on DVCs and RVCs for three reasons. First, they are used to encode motion events and state-change events, which are basic event types that children acquiring any language learn to talk about from an early age. Second, they are very frequent in Mandarin parent–child speech compared with other types of verb compounds. Third, the features of the two types of compounds raise interesting questions for larger issues concerning acquisition (to be discussed in Chapter 3).

To summarize, verb compounds constitute a particular type of construction in Mandarin. They can be distinguished from other serial verb constructions by their phonological, syntactic, and semantic features. Phonologically, most VCs constitute a single stress unit. Syntactically, they act like a single verb, with a compact relationship between the component verbs: nothing can come between them, the aspect marker follows the compound as a whole, and the compound as a whole takes a set of arguments just as simplex verbs do (e.g., NP_1 VC NP_2).

2.5 Compositional and lexical semantic properties of directional verb compounds

Directional verb compounds are typically used to encode motion events in Mandarin. Talmy includes situations of static location as a subtype of motion events, but since static location is not encoded with DVCs in Mandarin, I do not include it here.

[10] Li & Thompson (1981) classify DVCs as a subtype of RVCs, since they treat change of location as a subtype of change of state. I treat them as two subcategories of VCs to allow me to distinguish between the development of verb compounding in the semantic domains of motion events and state-change events.

DVCs are composed of two or maximally three verbs – V_1V_2 or $V_1V_2V_3$. The component verbs come from different semantic classes (cf. Chao, 1968; Kang, 1999; C. Li & Thompson, 1981; Lu, 1977; Zou, 1994) and the ordering of these verbs is fixed, as exemplified in (16) (optional verbs are shown in parentheses):

(16) a. *gun3-xia4(-lai2)* ‘roll-descend(-come)’ (roll down (towards speaker))
b. *fei1-lai2* ‘fly-come’ (fly towards speaker)
c. *xia4-qu4* ‘descend-go’ (go down)
d. *diao4-xia4(-lai2)* ‘fall-descend(-come)’ (fall down)
e. *reng1-chu1(-qu4)* ‘throw-exit(-go)’ (throw out)

In what follows, I describe the semantic classes of the component verbs. Note that unlike the constituents of English verb-particle constructions such as *go down,* or *run up*, all the elements in a DVC (V_1, V_2, and V_3) can be used as independent main verbs, with each one capturing one aspect of a motion event.

2.5.1 Semantic classes of Path verbs of DVCs

Since Path is the core event of a motion event, I start with Path verbs. Path verbs in Mandarin form a closed set: there are nine trajectory Path verbs that express the trajectory of the motion, such as *shang4* ‘ascend’ (up), and *xia4* ‘descend’ (down), and two deictic Path verbs that express the orientation of the motion, *lai2* ‘come’ and *qu4* ‘go’. The orientation of a motion reflects the perspective the speaker takes on the motion. If she takes her own perspective, she uses *lai2* for motion towards herself, and *qu4* for motion away from herself. If she takes the perspective of the hearer, she can use *lai2* ‘come’ to refer to a motion towards the hearer (but possibly away from herself), and *qu4* ‘go’ for a motion away from the hearer.[11]

Trajectory Path verbs or deictic Path verbs can combine as a V_2 with a Manner of motion verb to form a DVC, always in the second verb position (V_2) (see examples in 16 a, b, e). A trajectory verb can also combine as a V_1 with a deictic verb to form a two-verb DVC (V_1V_2) (16c). Table 2.1 exhibits all the possible combinations of trajectory Path verbs and

---

[11] The deictic meanings of *lai2* ‘come’ and *qu4* ‘go’ can also be used metaphorically. *Lai2* ‘come’ can convey the meaning of ‘be upon, acquire’. For example, in *Ta1 mai3-lai2 yi1 ben3 shu1* ‘He buy-come a book’, the referent of *ta1* ‘he’ becomes the possessor of the book and therefore only *lai2* ‘come’ can be used. A similar example is *zhao1-lai2* ‘invite-come’ (get oneself involved in). Q*u4* ‘go’ entails ‘off, separation, away’. For example, in *Ta1 jian3-qu4 le chang2fa1* ‘She cut-go PFV long.hair’ (she cut off her long hair), the hair separates from the referent of *ta1* ‘she’.

deictic Path verbs. A deictic verb always forms the last verb of a DVC, i.e., it is V_2 in a two-verb DVC and V_3 in a three-verb DVC (see examples in (16)).

Table 2.1. Mandarin Path verbs and their combinations with deictic verbs
(Note: Notations such as V_2 or V_3 indicate the position of a Path verb in a DVC with two or three component verbs.)[12]

V_2 / V_3	*shang4* 'ascend'	*xia4* 'descend'	*jin4* 'enter'	*chu1* 'exit'	*hui2* 'return'	*guo4* 'pass'	*kai1* 'part'	*qi3* 'rise'	*dao4* 'arrive'
lai2 'come'	*shang4-lai2* 'ascend-come' (come up)	*xia4-lai2* 'descend-come' (come down)	*jin4-lai2* 'enter-come' (come in)	*chu1-lai2* 'exit-come' (come out)	*hui2-lai2* 'return-come' (come back)	*guo4-lai2* 'pass-come' (come over)	-	*qi3-lai2* 'rise-come' (come up)	-
squ4 'go'	*shang4-qu4* 'ascend-go' (go up)	*xia4-qu4* 'descend-go' (go down)	*jin4-qu4* 'enter-go' (enter)	*chu1-qu4* 'exit-go' (go out)	*hui2-qu4* 'return-go' (return)	*guo4-qu4* 'pass-go' (go over)	-	-	-

2.5.2 Semantic classes of Manner of motion verbs of *DVCs*

Table 2.1 shows that DVCs composed of only Path verbs (i.e., trajectory verbs plus deictic verbs) form a closed set. But the productivity of DVCs lies in the possibility of combining Path verbs with a wide range of verbs from open sets whose members are always in the V_1 position in a DVC. I use V_1 to refer to a verb from these open classes. These include most typically Manner of motion verbs (e.g., *tiao4* 'jump'), verbs indicating the cause of a motion (e.g., *reng1* 'throw'), and verbs that entail a certain Path and Manner of motion (e.g., *diao4* 'fall', which entails downward motion in an uncontrolled manner). Note that V_1s do not necessarily in themselves encode a motion. For example, *ji3* 'squeeze', the V_1 of the DVC *ji3-chu1* 'squeeze-exit' (squeeze out), does not inherently encode motion. Rather, the motion meaning comes from its combination with a Path V_2 like *chu1* 'exit'. In other words, it is the DVC as a whole that encodes motion. Verbs that often appear in the V_1 position of a DVC are shown in (17), classified on the basis of their semantics.

(17) *Semantic classes of V_1 of DVCs*

a. Manner verbs encoding self-initiated motion, such as *zou3* 'walk', *fei1* 'fly', *pao3* 'run', and *pa2* 'crawl'. These verbs are intransitive and unergative (Kang 1999). Examples of DVCs with these verbs are *zou3-jin4* 'walk-enter' and *fei1-chu1* 'fly-exit'.

[12] The verb *dao4* 'arrive' is the only verb among the nine in this set that can be immediately preceded by the deictic verb *lai2* or *qu4*, as in *lai2-dao4* 'come-arrive' (come to, arrive at).

b. Transitive action verbs that specify the action that causes the change of location of the Figure, such as *nuo2* 'move (transitive)' in *nuo2-xia4-lai2* 'move-descend-come' (move down), *tui1* 'push' in *tui1-shang4-qu4* 'push-ascend-go' (push up), and *song4* 'send' in *song4-lai2* 'send-come' (send).

c. Verbs entailing both a Path and a certain Manner of motion: *diao4* 'fall (downward motion in an uncontrolled manner)', *chen2* 'sink' (downward motion in an uncontrolled manner), *dao3* 'topple', *luo4* 'fall (downward motion in an uncontrolled manner)', *sheng1* 'rise' (upward motion in an uncontrolled manner), *yue4* 'pass' (in a galloping manner), *di1* 'drop' (in a dribbling manner), *jiang4* 'descend, fall', *mo4* 'submerge', *tui4* 'withdraw', and *wei2* 'crowd around'. These verbs can be followed by a trajectory Path verb or a deictic Path verb, or both (as in Table 3.1), e.g., *diao4-xia4(-lai2)* 'fall-descend(-come)' (fall down), and *sheng1-shang4(-lai2)* 'rise-ascend(-come)' (rise up).

d. Posture verbs, e.g., *dun1* 'squat' in *dun1-xia4-lai2* 'squat-descend-come' (squat down), and *zuo4* 'stand' in *zuo4-qi3-lai2* 'sit-rise-come' (sit up).

In addition to specifying a physical change of location, DVCs can also be used metaphorically, when the V_1 comes from the list in (17e). Following Li & Thompson (1981), I term these *metaphorical DVCs*.

e. Verbs of inquiry, perception, saying, and mental state: for example, *cai1* 'guess' in *cai1-chu1-lai2* 'guess-exit-come' (make a right guess, figure out), *kan4* 'look' in *kan4-chu1-lai2* 'look-exit-come' (see, detect), *shuo1* 'speak' in *shuo1-chu1-lai2* 'speak-exit-come' (speak out), and *xiang3* 'think' in *xiang3-chu1-lai2* 'think-exit-come' (think out).

Stative adjectives[13] can also be the V_1s of DVCs, as exemplified in (17f). They often combine with a trajectory Path verb plus a deictic verb such as *qi3-lai2* 'rise-come', *shang4-lai2* 'ascend-come', *xia4-lai2* 'descend-come', and *xia4-qu4* 'descend-go'. The Path verb in such a DVC does not indicate the direction of a motion; rather, it is grammaticalized to mark aspect, and indicates a change of state.[14]

[13] Mandarin adjectives can be regarded as verbs when they function as predicates in a sentence, because they can directly be the predicate or center of the predicate without a copular verb (Zhao 1968: 663).
[14] For a detailed analysis of aspect marking by directional complement verbs, see Kang (1999).

f. Stative adjectival verbs, e.g., *hei1* 'be.dark', *re4* 'be.hot', and *liang4* 'be.bright', e.g., *hei1-xia4-lai2* 'be.dark-descend-come' (begin to turn dark), and *liang4-qi3-lai2* 'be.bright-rise-come' (begin to turn bright).[15]

To summarize, verbs from a wide range of semantic classes can occupy the V_1 slot of a DVC. These verbs combine flexibly with one or two Path verbs in a DVC that encodes motion events, either spontaneous or caused. Table 2.2 summarizes the distribution and combination of the semantic components of each verb of a DVC.

Table 2.2. Composition of directional verb compounds ($V_1V_2(V_3)$)

V_1	V_2	V_3	Examples	Glosses
Motion +Manner	Path		*zou3-jin4*	'walk-enter' (walk in)
Motion +Cause	Path		*reng1-jin4*	'throw-enter' (throw in)
Motion +Path	Path		*diao4-xia4*	'fall-descend' (fall down)
Motion +Manner	Deixis		*zou3-lai2*	'walk-come' (walk)
Motion +Cause	Deixis		*tui1-lai2*	'push-come' (push)
Motion +Path	Deixis		*shang4-lai2*	'ascend-come' (ascend)
Motion +Manner	Path	Deixis	*zou3-jin4-lai2*	'walk-enter-come' (walk in)
Motion +Cause	Path	Deixis	*tui1-chu1-qu4*	'push-exit-go' (push out)

2.6 Compositional and lexical semantic properties of resultative verb compounds

Resultative verb compounds are used to encode state-change events. They are composed of two verbs, with the V_2 indicating the result (either a change of property or an action) of the action or process represented by the V_1. For example:

(18) *Ta1 la1-kai1 le men2.*
He pull-open PFV door
'He opened the door by pulling on it.'

As illustrated in (18), *la1-kai1* 'pull-open' describes a state-change event consisting of two subevents: a causal event of "pulling" and a resultant event of "being open". Both component verbs can be used alone as full verbs, as shown in (19).

(19) *Ta1 la1 le men2, men2 kai1 le.*
He pull PFV door door open PFV
'He pulled on the door and the door opened.

[15] DVCs containing a stative adjectival verb convey a gradual state change (Kang, 2001). For example, *hei1-xia4-lai2* 'be.dark-descend-come' means to become darker and darker until it is completely dark.

A caused state change can also be encoded by another construction, the V-*de* resultative construction, as shown in (20) (the alternative encoding of such a state change with an RVC is shown in (21)). In this construction, unlike in an RVC, the resultant event is specified by an XP (a small clause) rather than a single verb.

(20)	*Ta1*	*ku1*	*de*	*shou3juan4*	*shi1*	*le.*
	He	cry	DE	handkerchief	wet	PFV

‘He cried such that the handkerchief was wet.’

(21)	*Ta1*	*ku1-shi*	*le*	*shou3juan4.*
	He	cry-wet	PFV	handkerchief

‘He cried the handkerchief wet.’

A V-*de* resultative construction can encode a more complex result state than an RVC – the resultative XP forms a tense domain, and can be a full-fledged sentence (Sybesma, 1999), as shown in (22):

(22) a.	*Ta1*	*xia4*	*de*	*lian3se4*	*fa1*	*bai2.*
	He	frighten	DE	face.color	turn	white

‘He was frightened such that his face turned white.’

b.	*Ta1*	*ku1*	*de*	*xiang3*	*si3*	*le.*
	He	cry	DE	want	die	PFV

‘He cried such that he wanted to die.’

c.	*Ta1*	*ku1*	*de*	*ma1ma1*	*bu4*	*zhi1*	*gai1*	*zen3me*	*ban4*	*le.*
	He	cry	DE	mother	not	know	should	how	do	PFV

‘He cried such that his mother did not know what do.’

Another difference between RVCs and the V-*de* construction is that RVCs do not allow degree modifiers such as *hen3* ‘very’, *fei1chang2* ‘extremely’, and *ji2* ‘very’ (even though the result verb alone can be so modified), whereas V-*de* resultatives do; compare the RVCs in (23a, b) with the V-*de* constructions (24a, b).

(23) a.	**Ta1*	*hen3*	*xi3-gan1jing4*	*yi1fu2.*
	He	very	wash-clean	clothes

‘He washed the clothes very clean.’

b.	**Ta1*	*fei1chang2*	*qie1-sui4*	*le*	*bai2cai4.*
	He	extremely	cut-be.in.pieces	PFV	cabbage

‘He shredded the cabbage very finely.’

(24) a. *Ta1 ba3 yi1fu2 xi3 de hen3 gan1jin4.*
He BA clothes wash DE very clean
'He washed the clothes very clean.'

b. *Ta1 ba3 bai2cai4 qie1 de fei1chang2 sui4.*
He BA cabbage cut DE extremely be.in.pieces
'He cut the cabbage very finely.'

A third difference between RVCs and V-*de* resultatives is that RVCs do not allow V_2 to be reduplicated, while V-*de* resultatives do. Reduplication of an adjective in Mandarin is a device for intensifying meaning, similar to the use of degree adverbs such as *hen3* 'very' and *fei1chang2* 'extremely'. Consider the following examples, first an RVC (25a, 25b) and then a V-*de* resultative (25c).

(25) a. *Ta1 ba3 zhuo1zi ca1-gan1jing4 le.*
He BA table wipe-be.clean PFV

b.**Ta1 ba3 zhuo1zi ca1-gan1gan1jin4jing4 le.*
He BA table wipe-be.clean-be.clean PFV

c. *Ta1 ba3 zhuo1zi ca1 de gan1gan1jing4jing4 le.*
He BA table wipe DE be.clean-be.clean PFV
'He wiped the table very clean.'

In sentence (25a) the result verb *gan1jing4* is bisyllabic, as it is composed of two different morphemes with more or less the same meaning. Each morpheme is reduplicated separately: *gan1gan1jing4jing4* 'be.clean-be.clean' (very clean) (as in (25b)); similarly, *zheng3qi2* 'be.tidy' – *zheng3zheng3qi2qi2* 'be.tidy-be.tidy' (very tidy). When a result complement is expressed with a reduplicated adjective, a V-*de* resultative must be used, as shown in (25c).

RVCs and the V-*de* construction constitute the resultative constructions of Mandarin. They both encode complex events comprising two subevents, a causal subevent and a subevent of result state or action. When the complex event is encoded by a multi-clause structure, this is the V-*de* resultative construction, and when it is encoded by a single lexical item, it is a resultative verb compound. In this dissertation, I examine children's acquisition of RVCs only, and leave the V-*de* resultatives for future study. I now move on to the semantic classes of the verbs that can appear in an RVC.

2.6.1 Semantic classes of the component verbs of RVCs

In an RVC, both V_1 and V_2 are drawn from open sets. V_1 is usually a transitive or an unergative verb denoting an activity, while V_2 is usually a stative verb (e.g., an adjectival verb) or a verb denoting certain kinds of actions. In general, the verbs that can occur as V_2 are more restricted than those that can occur as V_1. The possible results indicated by V_2 can be: (1) a physical state, like *kai1* 'open' in *ti1-**kai1*** 'kick-open'; (2) a mental state, like *dong3* 'understand' in *ting1-**dong3*** 'listen-understand'; and (3) an action, such as *xiao4* 'laugh' in *dou4-**xiao4*** 'amuse-laugh' and *ku1* 'cry' in *ma4-**ku1*** 'scold-cry'. Drawing on previous studies (Chao, 1968; F.-X. Li, 1993; Ma & Lu, 1997), I list some of the commonly used V_2s in Table 2.3. Most of the entries in Table 2.3 are adjectival verbs denoting a certain kind of state (mental or physical). Their counterparts are adjectives or past participles in English. I term RVCs containing such verbs *RVCs of physical or mental state* (RVCS). Action verbs seem to be very constrained in the V_2 slot: only two action verbs, *ku1* 'cry' and *xiao4* 'laugh', are found frequently as the V_2 of an RVC. I will discuss the constraints on action verbs in 2.8.4.

Table 2.3. List of common resultative complement verbs (V_2s) in RVCs (in alphabetical order)

No.	V_2	Gloss	No.	V_2	Gloss	No.	V_2	Gloss
1	*-ai3*	'short'	51	*-huang2*	'yellow'	101	*-qing1*	'blue-green'
2	*-an4*	'dark'	52	*-hun2*	'muddy'	102	*-qing1*	'clear'
3	*-bao3*	'full'	53	*-huo2*	'alive'	103	*-qing1*	'light'
4	*-ben4*	'dumb'	54	*-jia3*	'false'	104	*-qing1chu3*	'clear'
5	*-bian3*	'flat'	55	*-jian3dan1*	'simple'	105	*-qiong2*	'poor'
6	*-bing4*	'sick'	56	*-jian4*	'cheap'	106	*-quan2*	'full, complete'
7	*-bo2*	'thin'	57	*-jiang1*	'stiff'	107	*-re4*	'hot'
8	*-chang2*	'long'	58	*-jie1shi1*	'solid'	108	*-ruan3*	'soft'
9	*-chao2*	'damp'	59	*-jin3*	'tight'	109	*-ruo4*	'weak'
10	*-chen2*	'heavy'	60	*-jin4*	'near'	110	*-san3*	'loose'
11	*-chi2*	'late'	61	*-jiu3*	'long'	111	*-san4*	'scatter'
12	*-chuan1*	'pierced.through'	62	*-jiu4*	'old'	112	*-se4*	'jammed'
13	*-chou4*	'stink'	63	*-ke3*	'thirsty'	113	*-shao3*	'few, little'
14	*-cu1*	'thick'	64	*-kong1*	'empty'	114	*-shao4*	'youthful'
15	*-cui4*	'brittle, crisp'	65	*-ku1*	'cry'	115	*-shen1*	'deep'
16	*-cuo4*	'wrong'	66	*-ku3*	'bitter'	116	*-sheng1*	'raw'
17	*-da4*	'big'	67	*-kuai4*	'fast'	117	*-shi1*	'wet'
18	*-dai1*	'frozen'	68	*-kuan1*	'wide'	118	*-shou4*	'thin'
19	*-dao3*	'upside down'	69	*-la4*	'spicy'	119	*-si3*	'dead'
20	*-di1*	'low'	70	*-lan2*	'blue'	120	*-song1*	'lax, loose'
21	*-ding4*	'determined'	71	*-lan3*	'lazy'	121	*-suan1*	'sour'
22	*-dou3*	'steep'	72	*-lan4*	'smashed'	122	*-sui4*	'be in pieces'
23	*-duan3*	'short'	73	*-lao3*	'old'	123	*-teng2*	'painful'
24	*-duan4*	'broken'	74	*-lei4*	'tired'	124	*-tian2*	'sweet'
25	*-dui4*	'correct'	75	*-leng3*	'cold'	125	*-tou4*	'gone through'
26	*-dun4*	'blunt'	76	*-liang2*	'cool'	126	*-wai1*	'crooked'
27	*-duo1*	'much, many'	77	*-liang4*	'bright'	127	*-wan1*	'bent'
28	*-e4*	'hungry'	78	*-luan4*	'disorderly'	128	*-wan3*	'late'
29	*-er3xin1*	'nauseated'	79	*-ma2*	'numb'	129	*-xi4*	'fine'
30	*-fan1*	'turned.over'	80	*-man4*	'slow'	130	*-xian1*	'savory'
31	*-fan2*	'bored'	81	*-man3*	'full'	131	*-xian2*	'salty'
32	*-fan3*	'reversed'	82	*-mang2*	'busy'	132	*-xiang1*	'fragrant'
33	*-fei2*	'fat'	83	*-mao2*	'rough'	133	*-xiao3*	'small'
34	*-feng1*	'crazy'	84	*-mei2*	'gone'	134	*-xiao4*	'laugh'
35	*-fu3za2*	'complex'	85	*-mi2*	'infatuated'	135	*-xie2*	'slant'
36	*-fu4*	'rich'	86	*-ming2*	'explicit'	136	*-xin1*	'new'
37	*-gan1*	'dry'	87	*-ming2bai2*	'understand'	137	*-yang3*	'itchy'
38	*-gan1jing4*	'clean'	88	*-ni4*	'bored'	138	*-ying4*	'hard'
39	*-gao1*	'tall'	89	*-ning3*	'twisted'	139	*-yuan2*	'round, circle'
40	*-gou4*	'enough'	90	*-nong2*	'thick'	140	*-yuan3*	'far'
41	*-guang1*	'smooth'	91	*-nuan3he*	'warm'	141	*-yun2*	'even'
42	*-gui4*	'expensive'	92	*-pang4*	'fat'	142	*-zang1*	'dirty'
43	*-hao3*	'good'	93	*-pian2yi*	'cheap'	143	*-zao3*	'early'
44	*-hei1*	'dark'	94	*-piao4liang4*	'pretty'	144	*-zhai3*	'narrow'
45	*-hong2*	'red'	95	*-ping2*	'level'	145	*-zhen1*	'real'
46	*-hou4*	'thick'	96	*-po4*	'broken'	146	*-zheng3qi2*	'tidy'
47	*-hu2*	'scorched'	97	*-qi4*	'angry'	147	*-zheng4*	'right, correct'
48	*-hu2tu2*	'muddled'	98	*-qian3*	'shallow'	148	*-zhi2*	'straight'
49	*-hua4*	'melted'	99	*-qiang2*	'strong'	149	*-zhong4*	'heavy'
50	*-huai4*	'bad'	100	*-qiao3*	'smart'	150	*-zu2*	'adequate'

There is an additional semantic subcategory of V_2s, also frequent. Members of this category, which form a closed set, express something like the phase of action described by V_1 or the degree to which the action is carried out, rather than its result. RVCs containing such a verb are termed *phase* RVCs (C. Li & Thompson, 1981; Carlotta Smith, 1991), *attainment* RVCs (Packard, 2000), or *completive* RVCs (Carlotta Smith, 1990; Xiao & McEnery, 2004). Following Smith (1991), I use the term *Completive RVCs* (RVCC). Completive RVCs indicate the completion status of a situation; in contrast, result-state RVCs denote the result state. All the verbs that can appear as V_2s in a completive RVC are shown in Table 2.4.

Table 2.4. List of complement verbs (V_2s) of completive RVCs

	Completive complement verbs		Examples	
1	*-wan2*	'finish'	*chi1-wan2*	'eat-finish' (finish eating)
			nian4-wan2	'study-finish' (finish studying)
2	*-zhao2*	'be on target'	*cai2-zhao2*	'guess-be on target' (guess right)
			Sou1-zhao2	'search-be on target' (find)
3	*-zhu4*	'hold on'	*zhan4-zhu4*	'stand-hold on' (stand still)
			ting2-zhu4	'stop-hold on' (stop)
4	*-dao4*[16]	'reach, achieve'	*nong4-dao4*	'make-arrive' (get)
			zhao3-dao4	'search-arrive' (find)
5	*-hao3*	'good, ready, finish'	*xie3-hao3*	'write-complete' (complete writing)
			zuo4-hao3	'do-complete' (complete the task of doing)
6	*-jian4*	'see, perceive'	*kan4-jian4*	'look-perceive' (see)
			ting1-jian4	'listen-perceive' (hear)
7	*-diao4*	'fall, go away'	*guan1-diao4*	'turn-fall' (turn off)
			tuo1-diao4	'take-fall' (take off)
8	*-hui4*	'be able to / know'	*xue2-hui4*	'study-know' (learn)
			bei4-hui4	'recite-know' (be able to recite)
9	*-cheng2*	'achieve'	*zuo4-cheng2*	'do-achieve' (succeed in doing)
			nong4-cheng4	'make-achieve' (succeed in making)
10	*-guan4*	'be used to'	*shui4-guan4*	'sleep-be.used.to' (be used to sleeping)
			chi1-guan4	'eat-be.used.to' (be used to eating)

Completive RVCs (RVCCs) and RVCs of physical or mental state (RVCSs) both encode the completion of an action, but they differ in the relative emphasis they put on the action versus the result state (Xiao & McEnery, 2004). RVCCs explicitly express the completion of the action denoted by the V_1 and only imply a certain state change (either physical or mental). For example, *xi3-wan2* 'wash-finish' in (26a) asserts that the washing action itself is completed, and implies the achievement of a certain result (clean); that is, it does not actually specify whether the clothes end up clean or dirty. RVCSs, in contrast, assert that a certain result state is realized, and only imply that the causal action is complete. For example, *xi3-gan1jing4* 'wash-be.clean' in (26b) explicitly specifies that the result state of

[16] The meaning of *-dao4* is derived from its meaning as an independent verb 'arrive'. It can be glossed roughly as 'reach, achieve', and thus has a meaning similar to that of *-zhao2* 'be on target'.

being clean is achieved, as indicated by the second verb *gan1jing4* ‘be.clean’, but the completion of washing is only implied.

(26) a. *Ta1 xi3-wan2 le yi1fu2.*
He wash-complete PFV clothes
‘He finished washing the clothes.’

b. *Ta1 xi3-ganj1ing4 le yi1fu2.*
He wash-be.clean PFV clothes
‘He washed the clothes clean.’

In summary, an RVCS entails a state change and implies the completion of the action specified by V_1, whereas a completive RVC entails the completion of the action specified by V_1 and is moot about whether the state change is achieved.

2.6.2 The state-change meaning in an RVC and its component verbs

As discussed earlier, Mandarin RVCs encode state changes (which include the completion of a causal action and the resulting state change of the affected object). This particular way of lexicalizing state change contrasts with that of other languages. For example, Germanic languages like English and German encode state-change meanings in several ways: (1) with monomorphemic verbs like *pick (an apple)* and *break*, which conflate both a (generic) causal event and a state change; (2) by combining a monomorphemic state-change verb with a particle or complement phrase which adds further information about the state change encoded by the verb (e.g., *pick off, break into pieces*); (3) by combining a verb that specifies only an action with a particle or a complement phrase that specifies the result state caused by this action (e.g., *blow out (a candle))*. Mandarin has few monomorphemic state-change verbs like English *pick, break,* and *kill*. In general, an RVC as a whole constitutes the semantic counterpart of an English monomorphemic state-change verb. The state-change meaning of an RVC is entailed and indefeasible, just as it is in English monomorphemic state-change verbs. This is illustrated in (27):

(27) #*Ta1* ***sha1-si3*** *le na4 zhi1 niao3, dan4 ta1 mei2* ***si3***.[17]
He kill-die PFV that CLF bird but it not die
‘He killed that bird, but it did not die.’

[17] The symbol cross-hatch (#) is used to indicate semantic anomaly (as opposed to *, which indicates ungrammaticality).

The RVC *sha1-si3* ‘kill-die’ entails a state change of becoming dead, which clashes with the claim in the second clause that the bird did not die. In contrast, the V_1 of this RVC, *sha1* ‘kill’, when used alone, may imply a state change but does not entail it. This is illustrated in (28), which is felicitous in Mandarin:

(28) *Ta1* ***sha1*** *le* *na4* *zhi1* *niao3,* *dan4 ta1 mei2* ***si3****.*
He kill PFV that CLF bird but it not die
‘He killed the bird, but it did not die.’ (e.g., he shot it, but it did not die.)

An RVC, by its composition, neatly subdivides a causal event into two subevents – the cause (V_1) and the result (V_2). The two verbs together convey the state-change meaning. As Talmy (2000) argues, the referential terrain covered by a typical English state-change verb such as *kill* is thus conceptually divided into two portions in Mandarin: the outcome, conclusively confirmed by the result verb, and the action that leads to this outcome, specified by the action verb. Talmy points out that the majority of Mandarin action verbs (V_1s) are either of the “moot fulfillment” type (the verb does not in itself make any assertion about a state change) or the “implied fulfillment” type (a particular state change is implied, but not entailed).

This semantic arrangement raises questions about language acquisition. How do Mandarin children figure out this Mandarin method of encoding state change, and how do they learn the semantic division of labor between the component verbs? I discuss this learning problem in Chapter 5.

2.7 The productivity of verb compounding in Mandarin

In the preceding sections, I have presented the compositional features of DVCs and RVCs. The variety of verb types that can go into making up a DVC or an RVC suggests that verb compounding is very productive. As mentioned in Chapter 1, new compounds can indeed be created on the spot. Productivity is also shown by the flexibility of the V_2s that can occur with a given V_1, and of the V_1s with a given V_2. That is, the same V_1 can combine with many different V_2s, for example, *ti1-kai1*, ‘kick-be.open’, *ti1-po4* ‘kick-be.broken’, *ti1-sui4* ‘kick-be.in.pieces’, and *ti1-dao3* ‘kick-fall’. Conversely, the same V_2 can combine with many different V_1s, for example, *si1-kai1* ‘tear-be.open’, *jian3-kai1* ‘cut-be.open’, and *bai1-kai1* 'bend-be.open'.[18] The component verbs can be either transitive or intransitive. For example, *ti1-po4* 'kick-be.broken' is composed of a transitive verb (V_1) and an intransitive verb (V_2). In (29), the V_1 of the RVC *zuo4-huai4* 'sit-be.broken' – *zuo4* 'sit' – is an intransitive stative verb.[19]

(29) *Ta1* ***zuo4-huai4*** *le* *yi3zi1.*
He sit-be.broken PFV chair
'He sat the chair broken (broke the chair by sitting on it).'

The productivity of verb compounding is shown further in the possibility of combining verbs that specify different (and even conflicting) semantic relations between the causal action and the caused result. These semantic relations include what Talmy (2000) has termed "fulfillment" results, "over-fulfillment" results, "anti-fulfillment" results, "under-fulfillment" results, and "other event" results, as illustrated in (30):

(30) *Wo3 ba3 gun4zi* ***wan1-wan1 / wan1-she2 / wan1-zhi1 / zhe2-wan1*** *le.*
I BA stick **bend-be.bent / bend-be.broken / bend-be.straight / break-be.bent** PFV
fulfillment / over-fulfillment / antifulfillment / under-fulfillment
'I bent the stick bent / broken / straight.'
'I was breaking the stick (with an intention to break it) and it turned out bent'.

The RVC *wan1-wan1* 'bend-be.bent' can be used to refer to situations in which someone presses on the two ends of a stick and causes it to become bent. The V_1 *wan1* implies an intended result state of becoming bent, and the V_2 *wan1* 'be.bent' confirms this state-change implicature. Thus it is termed a "fulfillment" result by Talmy. *Wan1-she2* 'bend-be.broken' and *wan1-zhi1* 'bend-be.straight' refer to situations in which the stick ends up being broken (i.e., bent to the degree of being broken) or being straight rather than bent (perhaps due to the resilience of the stick). Note that in the usual course of executing the intention expressed by *wan1* 'bend', a bent state for the patient can be a step on the way to a broken state. Thus *wan1-she2* 'bend-be.broken' marks an over-fulfillment of the scope of the intended 'becoming bent'. Conversely, *zhe2-wan1* 'break-be.bent' marks an under-fulfillment of the full scope of

[18] The glosses are not precise since the verbs have no exact semantic counterparts in English. I discuss the semantics of Mandarin cutting and breaking verbs in Chapter 6.
[19] English does not allow resultative constructions such as *sit the chair broken*, and *polish the shoes shined*, due to a constraint on the use of past participles (e.g., *broken, shined*) as the resultative complement (Green, 1972). Mandarin does not have morphological marking for past participles, and the Mandarin counterparts of English past participle adjectives are the most common V_2s in RVCs.

the intention of breaking something. Resultatives like "bend broken"[20] and "bend straight" are impossible in English. English "implied-fulfillment" verbs like *bend* convey a "lexicalized implicature" (Talmy, 2000) — that the agent's goal of bringing about a certain result has been attained. *Bend* can therefore only take a resultative complement that confirms this goal attainment, as in *I bent the stick into a curve* (fulfillment). A sentence like *?I bent the stick straight* contradicts the implied result, so it is infelicitous.

The productivity of Mandarin RVCs is shown still further by the fact that a compound verb can be predicated of either the *object* or the *subject* of a sentence. English resultatives, in contrast, are subject to the so-called Direct Object Restriction (DOR) (e.g., Simpson, 1983), which states that they can only be predicated of objects or arguments bearing the thematic role of patient. The object can be an argument of the main verb, as in (31a). Alternatively, it can be the 'surface' object of an intransitive verb such as *run* in a resultative construction like *They ran the pavement thin* in (31b); note that such a verb cannot take an object independently of this construction (**They ran the pavement).* In still other cases the object can be the subject of an unaccusative verb (which is often interpreted as an underlying object), as in (31c), or the subject of a passive (again, an underlying object), as in (31d), or a "fake reflexive" object of an intransitive verb of the unergative class, as in (31e). (In these examples, "RC" means "Resultative Construction".)

(31) a. Mary wiped the table$_i$ clean$_i$. (RC with a V_{TR})
b. They ran the pavement$_i$ thin$_i$. (RC with a V_{INTR})
c. The ice$_i$ froze solid$_i$. (RC with an unaccusative V_{INTR})
d. The door$_i$ was kicked open$_i$. (RC in a passive)
e. They yelled themselves$_i$ hoarse$_i$. (RC with a V_{INTR} and a "fake reflexive")

Ungrammaticality arises when the intended predication of the resultative phrase goes to the underlying subject of the sentence, as illustrated in (32):

(32) a. *I$_i$ melted the steel hot$_i$. (This cannot mean: I melted the steel until I was hot.)
b.*I$_i$ ate the food full$_i$ / sick$_i$. (This cannot mean: I ate until I was full/ sick.)

The DOR constraint does not apply to RVCs in Mandarin. It is easy to find sentences like (33a, b), in which the result verb (V_2) is predicated of the subject of the sentence:

[20] "Bend broken" is also ruled out in English because of the constraint against past participles as resultative complements. See fn. 19.

(33) a. *Ta1$_i$* ***chi1$_i$-bao3$_i$*** *le* *fan4.*
He **eat-be.full** PFV food
'He ate (himself) full of food.'

b. *Ta1$_i$* ***zou3$_i$-lei4$_i$*** *le.*
He walk-be.tired PFV
'He walked (himself) tired.'

This predication relationship is particular common for RVCs with a psychological verb as V_2, like *kan4-pa4* 'see-scared', *kan4-lei4* 'watch-tired', *chi1-gao1xing4* 'eat-happy', and *he1-xing1fen4* 'drink-excited'.

English resultative constructions are subject to a further constraint known as the "Animate Instigator Constraint" (Goldberg, 1991), which specifies that only an animate instigator argument is acceptable as the subject of an English resultative construction. This is illustrated in (34) and (35):

(34) *The feather tickled her silly.

(35) *The hammer pounded the metal flat.

Mandarin, in contrast, allows not only animate but also inanimate instigators (e.g., instruments), as illustrated in (36):

(36) *Chui2zi* *chui2-ping2* *le* *na4* *kuai4* *jin1shu3.*
Hammer hammer-flat PFV that CLF metal.
'The hammer hammered the metal flat.'

To summarize, the productivity of DVCs and RVCs is demonstrated by the wide range of semantic categories to which their component verbs can belong, the flexibility with which different V_1s can be combined with the same V_2 and different V_2s with the same V_1, and the variety of semantic relations that are possible between the causal action and the caused result (i.e., fulfillment, over-fulfillment, anti-fulfillment, and other-event). At the level of the entire sentence, productivity is seen in the flexibility of the possible syntactic relations that can hold between the component verbs and their arguments. That is, the V_2 of an RVC can be predicated of either the object or the subject argument, and the subject can be either an agent or an instrument of the causing event.

DVCs and RVCs also exhibit their productivity in a morphological process, the construction of their "potential" forms. The potential forms – which are probably frequent in speech to young children – involve inserting a "potential" infix, *-de-* 'able' (positive potential form) or *-bu-* 'not' (negative potential form) between the V_1 and the V_2. The potential forms mark the ability or inability of the agent to realize the change of location or state denoted by the V_2 by conducting the action denoted by the V_1. This is illustrated in (37) for a DVC and in (38) for an RVC.

(37) a. *Ta1* ***pa2-de-shang4-qu4*** *na4* *zuo4* *shan1.*
He climb-able-ascend-go that CLF mountain
'He is able to climb up that mountain.'

b. *Ta1* ***pa2-bu-shang4-qu4*** *na4* *zuo4* *shan1.*
He climb-not-ascend-go that CLF mountain
'He is unable to climb up that mountain.'

(38) a. *Ta1* ***la1-de-kai1*** *na4* *shan4* *men2.*
He pull-able-be.open that CLF door
'He is able to open that door by pulling on it.'

b. *Ta1* ***la1-bu-kai1*** *na4* *shan4* *men2.*
He pull-not-be.open that CLF door
'He is unable to open that door by pulling on it.'

The sentences in (37) are interpreted as specifying that agent is able or unable to climb up the mountain due either to his ability (e.g., his fitness) or to some property of the mountain (e.g., its height). Similarly, the sentences in (38) indicate that the pulling can or cannot lead to the door's being open, due either to the agent's ability or some property of the door.[21]

Up to now, I have been emphasizing the productivity of Mandarin DVCs and RVCs. In languages that allow compounding, it is often possible to coin a compound on the spot as long as it makes sense in context. But there are still certain kinds of combinations that will not be acceptable to native speakers. Although it is difficult to capture the subtle constraints on combination, adult native speakers have an intuition for them. In what follows, I try to

[21] A few RVCs do not have potential forms, e.g., *gai3-liang2* 'renovate-be.good' (**gai3-de-liang2* 'renovate-able-be.good') and *jie3-chu2* 'unfasten-remove' (**jie3-de-jue2* 'unfasten-able-remove). These RVCs are known as "solid resultative verb compounds" because the potential infix cannot intervene between the component verbs (Chao, 1968: 437).

formulate certain constraints on the formation of DVCs and RVCs with the goal of identifying some possible difficulties for children learning Mandarin.

2.8 Constraints on the formation of DVCs and RVCs

2.8.1 Iconicity and ordering constraints

As described in sections 2.2 and 2.3, the constituents of both DVCs and RVCs occur in a fixed order. This ordering reflects the iconicity principle (Haiman, 1985; Uehara, Li, & Thepkanjana, 2001): the order of the component verbs follows the temporal order of occurrence of the events. In an RVC, the verb denoting the causal action precedes the verb denoting the result, and in a DVC, the motion verb (manner or cause) precedes the directional verb and the deictic verb. Consider the DVC *zou3-jin4* 'walk-enter', for example. The subevent of entering cannot take place before the action of walking. That is, walking and entering either unfold at the same time or one ("walking") begins before the other ("entering"). Similarly, in a DVC with a transitive V_1 of displacement, such as *reng1-chu1*'throw-exit', the subevent of exiting cannot happen before the subevent of 'throwing'. English resultative constructions show a similar ordering constraint. This contrasts with certain other languages, such as Korean and Japanese, in which the order in resultative constructions is the opposite: the resultative subevent is mentioned before the action (Uehara, Li, & Thepkanjana, 2001).

2.8.2 The Unique Path constraint

Does Mandarin allow the concatenation of more than one verb to describe a change of location or a change of state? For example, can we create VCs like *da3-xia4-po4* 'hit -descend-be.broken' to describe an event in which someone hits a pot and it falls and breaks? According to my own intuition and that of five other native Mandarin speakers, such VCs are strange. A Path verb, e.g., *xia4* 'descend', and a result verb, e.g., *po4* 'be.broken', cannot be combined to describe both a change of location and a change of state of the same affected object. Nor can two state-change verbs co-occur to denote a double state change, e.g., **da3-po4-lou4* 'hit-be.broken-leak' (hit a pot, causing it to break and leak) and **she4-zhong4-si4* 'shoot-be.on.target-die' (shoot at someone and hit him, causing him to die).

This constraint is reminiscent of one discussed by Goldberg (1991b) and Levin and Rappaport (1995, 1998), who point out that in English, resultative constructions with both a resultative phrase and a directional phrase are unacceptable. An example is shown in (39).

(39) *Bob kicked Sue black and blue down the stairs.

Sentence (39) contains two complements, specifying two different types of changes undergone by the referent of *Sue: black and blue,* a physical change, and *down the stairs*, a location change. There are many similar examples. For example, a trajectory Path verb of motion is prohibited from combining with a resultative complement that specifies a state change, as in **ascend sick* ‘get sick as a result of ascending’. Nor can an overt Path satellite combine with a phrase that specifies the trajectory of motion, as in **kick down descending the stairs*.[22] A state-change verb is also prohibited from combining with a PP indicating a change of location, as in **Kelly broke the dishes off the table*. Double-resultative combinations, in which more than one resultative phrase occurs, are prohibited as well, as in **kick him bloody dead* and **wipe the table dry clean* (examples from Goldberg, 1991a).[23]

The ungrammaticality of these resultative constructions is argued to stem from a general constraint against specifying more than one *different* result state in a resultative construction. This constraint has been termed the *Unique Path constraint* by Goldberg, who uses the notion of Path (literal or metaphorical) as a general term to cover changes of both location and state (i.e., she interprets state change as involving a metaphorical Path). This constraint is compatible with the more general constraint that an eventuality can only have one delimitation (Tenny, 1987). For example, (39) is ruled out because the event of kicking has two totally *different* endpoints, indicated by the resultative phrases *black and blue* and *down the stairs*.

Goldberg and Levin and Rappaport Hovav have also noted exceptional cases like (40) and (41), where a state-change verb combines with another resultative phrase.

(40) a. He cracked the egg into the bowl.

b. He sliced the mushrooms onto the plate.

---

[22] This constraint does not hold for combinations of a motion verb that encodes Path information lexically with a particle that encodes a trajectory that is coherent with this Path, such as *rise up* and *lower down*.

[23] According to Goldberg (1991a), the *Unique Path* constraint allows two non-verbal predicates to co-occur as long as they do not specify two distinct changes of state. If one of the predicates is depictive, for example, they may co-occur, as in *The clay won’t set stiff cold* and *You can rub the clay smooth wet* (resultative + depictive).

(41) a. He broke the plate into pieces.

b. The bottle broke open.

Levin and Rappaport Hovav (1995) argue that these cases do not falsify the *Unique Path* constraint. They explain that in cases like (40), the two entailed results concern TWO entities, not just one – for example, in (40a) the egg being cracked refers to the egg as a whole, and the egg that ends up in the bowl refers to the part of the egg inside the shell. So the grammaticality of constructions like (40) is due to their object NP, which can be understood to refer inherently to two entities, each of which can have a change predicated of it. Sentences like those in (41) are allowed for a different reason. In (41a) and (41b), the resultative phrases *into pieces* and *open* constitute further specifications of the state that is already part of the meaning of *break*. Since they do not specify a second result state in addition to the state inherently specified by *break*, these phrases can co-occur with the verb. So the *Unique Path* constraint still holds for English resultative constructions.

Like English, Mandarin does not allow the combination of verbs denoting two different types of results, such as **da3-xia4-po4* 'hit-descend-be.broken' (hit a pot, causing it to fall and break) or **ji3-po4-lou4* 'squeeze-be.broken-leak' (squeeze an egg, causing it to break and leak). The ungrammaticality of these compounds suggests that Mandarin VCs are also subject to the *Unique Path* constraint: Mandarin does not allow the combination of verbs that specify two different state changes, two different Paths or location changes, or a state change plus a location change.

2.8.3 Semantic constraint on V_1s of DVCs: The Congruent Path constraint

As discussed in §2.5.2, the V_1 of an DVC can be a verb entailing a Path of motion, such as *sheng1* 'rise' and *jiang4* 'lower' (see (19c) for examples). It has been observed that in a well-formed DVC, the Path information conveyed by the component verbs must be semantically congruent (Kang, 1999; Zou, 1994). This constraint is called the *Congruent Path constraint* (Zou, 1994). DVCs with congruent Paths include, for example, *sheng1-shang4-qu4* 'rise-ascend-come' and *jian4-xia4-qu4* 'lower-descend-go'. DVCs with incongruent Paths, in contrast, include **sheng1-xai4-lai2* (rise-descend-come) and **jiang4-shang4-qu4* (lower-ascend-go). The notion of congruence also applies to metaphorical Paths, as illustrated in (42):

(42) a. *Ta1 mai3-jin4 le yi1 pi1 huo4.*
He buy-enter PFV one CLF goods
'He bought into his possession a pack of goods.'

b. *#Ta1 mai3-chu1 le yi1 pi1 huo4.*
He buy-exit PFV one CLF goods
'He bought out of his possession a pack of goods.'

In (42a) V_1 *mai3* 'buy' is an action verb which specifies that something comes into someone's possession, and *jin4* 'enter' denotes an action of entering. So the two verbs are compatible in combination. In contrast, *chu1* 'exit' specifies an outgoing motion, so it is incompatible with the coming into possession notion denoted by *mai*3 'buy'.

2.8.4 Semantic constraints on V_2s of RVCs

Verbs that can appear in the V_2 slot of an RVC are more restricted than verbs that can appear in the V_1 slot, even though the V_2s of RVCs are open-class items. For example, compounds such as **da3-tiao4* 'hit-jump' (hit someone, causing him to jump) and **xia4-jiao4* 'frighten-shout' (frighten someone, causing him to shout) are unacceptable. Recall Table 2.3, which shows more than a hundred different verbs commonly used as the V_2 of an RVC. Most of them are adjectival verbs; action verbs[24] are quite rare, except for *ku1* 'cry' and *xiao4* 'laugh'. In the real world, however, it is not uncommon to see events involving caused actions (in addition to caused state changes), such as shouting as a result of being frightened. Why then are certain verbs like *jiao4* 'shout' not allowed in the V_2 position in an RVC? Is there a consistent pattern behind all the 'disallowed' V_2s (action verbs and maybe other types of verbs)? Or are these just arbitrary idiosyncrasies of Mandarin?

The issue of constraints on compounding is analogous to the well-studied question of constraints on argument structure alternations – in particular, on the alternation between intransitive inchoative verbs and transitive causative verbs of the same form, e.g., *The stick broke* vs. *John broke the stick*. The Mandarin counterpart of the transitive causative verb *break*, in *John broke the stick*, is the RVC *bai1-duan4* 'bend-be.broken': it is ungrammatical to use the result verb (V_2) *duan4* 'be.broken' alone to express the caused state change, as in

[24] In the literature, action verbs are described as involve agentivity and intention (i.e., volition). Typical tests for action verb status include determining whether the verb can be embedded in a frame like *What he did was to –,* or whether the verb is compatible with adverbs that denote volition, such as *deliberately, carefully* (e.g., Dowty, 1979). For example, by these tests the verb *zhi1dao4* 'know' is not an action verb, since it is awkward to say *What he did was to know the story* or *He knew the story deliberately.*

**John duan4 le gun4zi* ‘John be.broken PFV stick’. Asking which verbs can be the V_2 of an RVC is thus equivalent to asking which verbs can be causativized through compounding.

In early classical Chinese (around 500 BC to 200 BC), result verbs such as *sui4* ‘be.in.pieces’ were used as causatives, but in modern Mandarin they must be combined with an action verb to receive a causative interpretation. There has been a diachronic morphological shift in Mandarin from monomorphemic causatives to compounding causatives (Jiang, 1999; F.-X. Li, 1993), with monomorphemic causative verbs having decausativized to become inchoatives or statives. Even when a result verb may, exceptionally, serve directly as a causative verb, as in *ta1men2* ***chen2*** *le na4 sou1 chuan2* ‘They **sank** that boat’ (cf. *na4 sou1 chuan2* ***chen2*** *le* ‘That boat **sank**’), VCs such as *nong4-**chen2*** ‘make-**sink**’ or *zha4-**chen2*** ‘explode-**sink**’ are more natural and colloquial, according to my native speaker intuitions.

What are the constraints on which verbs can be V_2 of an RVC? Let us first examine proposals based on the analysis of English and then determine whether the same constraints apply to Mandarin compounding. Levin (1993; Levin & Rappaport Hovav, 1995) and Pinker (1989) propose that there are semantic rules governing causativization. For example, the causative use of an intransitive verb presupposes “direct” causation (Pinker [1989] captures this with his “broad-range” lexical rule governing causativization; see §3.4.2); this means that verbs of “internal causation” cannot causativize. For example, although we can amuse a baby and cause it to smile, we cannot say **I smiled the baby*. This is because our actions result only indirectly in the smiling response, since the smile is mediated by the smiler’s own control. The same is true for *laugh* and *cry*.

Even within the class of verbs expressing events with an external cause, Pinker (1989) argues that there are language-specific semantic rules (which he terms “narrow-range” lexical rules) that govern which types of verbs can alternate between a causative and an intransitive inchoative use (see also §3.4.2). Alternating verbs, as well as nonalternating verbs, form distinct semantic classes. Alternators in English preeminently include verbs of extrinsic change of physical state (e.g., *open, close*), motion taking place in a particular manner (e.g., *bounce, roll*), and instrument of locomotion (e.g., *drive, fly*). Nonalternators include verbs of motion in a lexically specified direction (e.g., *fall, rise*), verbs of volitional or internally caused actions (e.g., *eat, sing*), verbs of coming into or going out of existence (e.g., *die, expire*), verbs of emotional expression (e.g., *smile, cry*), and verbs of motion-contact-effect (e.g., *cut, slice*).

Inspired by Levin's and Pinker's semantic account of the causative alternation, I have examined whether the Mandarin verbs that cannot occur as V_2 in an RVC correspond to nonalternating verbs in English. On the basis of my own intuitions and those of two other native speakers of Mandarin, I have identified the following semantic classes of verbs (some names for these classes are adopted from Pinker's [1989] study).

(43) *Semantic classes of verbs that are not allowed in the V_2 position of an RVC:*

a. Verbs of manner of motion (internally or externally caused)[25]: *hua2* 'slide', *piao1* 'float', *zhuan4* 'spin', *xuan2* 'spin', *gun3* 'roll', *beng4* 'hop', *yue4* 'skip', *liu2* 'flow', *pa2* 'crawl', *tan2* 'spring', *tiao4* 'jump', etc.

b. Verbs of volitional action (internally caused): *chi1* 'eat', *he1* 'drink', *chang4* 'sing', *mai3* 'buy', *wu3* 'dance', *han3* 'shout', *jiao4* 'shout', *shuo1* 'speak', *qie1* 'cut.with.single.blade', *jian3* 'cut.with.double.blade', *tui1* 'push', *da3* 'hit', etc.

c. Verbs of emotion (internally caused): *ai4* 'love', *hen4* 'hate', *zeng4* 'loathe', etc.

d. Posture verbs (internally caused): *zhan4* 'stand', *li4* 'be.erect, stand', *zuo4* 'sit', *tang3* 'lie', *dun1* 'squat', *pa1* 'lie face downward', etc.

e. Verbs meaning 'stop' or 'close' (internally or externally caused): *ting1* 'stop', *zhi3* 'halt, stop', *guan1* 'close', *bi4* 'shut, close', etc.

RVCs with a V_2 from one of these classes sound odd to adult ears; these include, for example, **an4-dun1* 'press-squat' (e.g., someone presses on another person, causing her to squat), **ti1-gun3* 'kick-roll' (a boy kicks a ball and it rolls away), **peng4-guan1* 'touch-close' (somebody touches an open box and it closes), and **zhuang4-ting2* 'bump stop' (two cars bump together and stop).

The non-alternating verbs in (43b, c, d) all express internally-caused events. Mandarin, like English, seems sensitive to the distinction between internal and external causation, and in general blocks verbs specifying internally-cause from the V_2 position of an RVC.[26] But the dotted line provided by this constraint is imperfect.

---

[25] Two manner of motion verbs, *pao3* 'run', and *zou3* 'walk', do appear in DVCs such as *gan3-pao3* 'drive-run' and *gan3-zou3* 'drive-walk', but in these compounds the verbs have a grammaticalized meaning, 'be away', and no longer express manner of motion. *Pao3* 'run' and *zou3* 'walk' are interchangeable in this use.

[26] Gu (1992) has proposed a constraint similar to what is considered here – volitional verbs are not allowed as the V_2 of an RVC (see also Shen 1993). Volitionality can be tested by determining the verb's compatibility with adverbs like *gu4yi4de* 'deliberately' and *yong4li4de* 'forcefully'. By this test, verbs like *tiao4* 'jump' are unergatives, and involve volitional actions performed by an actor; they are thus unable to be the V_2 of an RVC.

First, consider Mandarin manner of motion verbs: these cannot serve as the V_2 of an RVC even when they express an externally-caused event (these include most of the verbs in (43a)). For example, **tui1-gun3* 'push-roll' (cause to roll by pushing) is not acceptable even though the rolling is externally caused. In contrast, most English manner of motion verbs can alternate between inchoative and causative uses (Levin, 1993), as in *The ball rolled* and *He rolled the ball.* Levin (1993) suggests that lack of internal causation of the motion is in fact the crucial semantic feature that allows manner of motion verbs to alternate. Manner of motion verbs like *glide* and *drift* do not participate in this alternation since gliding and drifting are not typically externally controllable. Mandarin, however, allows neither the *roll*-type nor the *glide*-type of manner of motion verbs to be causativized through compounding.

Next, consider Mandarin verbs that express internal causation. By the constraint under consideration these should not be able to serve as the V_2 of an RVC, but a number of them do; these include the verbs of emotional expression *ku1* 'cry' and *xiao4* 'laugh', as in *da3-ku1* 'hit-cry' and *dou4-xiao4* 'amuse-laugh, and the verbs of emotional state *nao3* 'be.annoyed' and *fan2* 'be.bored', as in *re3-nao3* 'disturb-be.annoyed' and *ting1-fan2* 'listen-be.bored'.[27] Gu (1992) proposes that emotion-related verbs such as *cry* and *laugh* do not involve typical agentivity (volition), and in cases when crying and laughing occur as the result of a provoking action, the subject of 'cry' or 'laugh' is construed as an Experiencer. So by this argument, non-volitional Experiencer verbs can be the V_2 of an RVC. But the verbs shown in (43c) clearly contradict this conclusion: with only a few exceptions, non-volitional Experiencer verbs *cannot* be the V_2 of an RVC; *ai4* 'love', and *hen4* 'hate' are cases in point.

Gu (1992) accounts for this contradiction by proposing another semantic constraint: only verbs capable of expressing a change of state can serve as V_2. Mandarin adjectival stative verbs such as *shi1* 'be.wet' and *hei1* 'be.dark' can express a state change, according to Gu, because they can be used as stage-level predicates as well as individual level predicates, i.e., they can describe either a change of state, as in *Tian1 hei1 le* 'Sky dark PFV' (it turned dark), or a property of an entity that exists regardless of time, as in *Ta1 yan3jing1 hei1* 'She eye dark' (her eyes are dark). In contrast, verbs such as *ai4* 'love' and *hen4* 'hate' are pure

[27] Mandarin emotion verbs tend to be bisyllabic, e.g., *gao1-xing4* 'be.happy', *nan2-guo4* 'be.sad', and *tong4-ku3* 'be.painful'. Bisyllabic words in general are not used as the V_2 of an RVC. Exceptional cases are *gan1-jing4* 'be.clean' and *zheng3-qi2* 'be.tidy', as in *xi3-gan1-jing4* 'wash-be.clean' and *die2-zheng3-qi2* 'fold-be.tidy' (fold clothes).

stative verbs, and so can only be used as individual level predicates, as in *John ai4 Mary* ‘John love Mary’ (John loves Mary).

But it still remains a puzzle why the verbs in (43e), i.e., verbs of closure or ceasing such as *guan1* ‘close’ and *ting2* ‘stop’, cannot be the V_2 of an RVC. Compounds like **da3-guan1* ‘hit-close’ and **da3-ting2* ‘hit-stop’ are distinctly odd. Note that these verbs can express either externally- or internally-caused events, and they can be stage-level predicates expressing a state change. The constraint against this class of verbs seems to be idiosyncratic, especially when we consider that *kai1* ‘open’, which is the antonym of *guan1* ‘close’, is frequent as the V_2 of an RVC. I will leave the explanation of this phenomenon to further research.

To summarize, Mandarin, like English, shows a general semantic constraint against using verbs that specify an internally-caused event in a causative construction (as the V_2 of an RVC in Mandarin and as a transitive causative in English). But in Mandarin certain emotion-related verbs are exceptions to this constraint. Still puzzling is why verbs of externally-caused manner of motion and verbs of closure or cessation cannot be the V_2 of an RVC, even though they are not ruled out by this constraint.

2.8.5 Semantic constraints on V_1s of RVCs

As described in §2.6.1, the V_1s of an RVC are less constrained than the V_2s. One obvious constraint, however, is that unaccusative verbs that denote only a state change cannot be the V_1, as the examples in (44) attest.

(44) a. * *Zhang1san1 si3-ku1 le Li3si4.*
Zhangsan die-cry PFV Lisi.
‘Zhangsan died and as a result Lisi cried.’

b. **Zhang1san1 lai2-fan2 le Li3si4.*
Zhangsan come-annoy PFV Lisi
‘Zhangsan came and as a result Lisi was annoyed.’

In general, transitive verbs and unergative verbs denoting volitional activities can be the V_1 of an RVC. But certain non-volitional verbs can also be the V_1, such as *fan2* ‘annoy’ in *fan2-si3* ‘annoy-die’ and *qi4* ‘anger’ in *qi4-ku1* ‘anger-cry’, as in (45).

(45) a. *Zhe4 zhong3 zao4yin1 fan2-si4 le Li3si4.*
This kind noise annoy-die PFV Lisi
'This kind of noise annoyed Lisi to death.'

b. *Tiao2pi1 de Dandan qi4-ku1 le jie3jie.*
Naughty DE Dandan anger-cry PFV elder.sister
'Naughty Dandan enraged (her) elder sister to tears.'

In such cases verbs like *fan1* and *qi4* have a causative reading: 'to cause someone to be annoyed', 'to cause someone to be angry'. These verbs are among the few Mandarin verbs that can alternate between an intransitive use and a transitive causative use. For example, as an intransitive verb, *fan2* indicates a psychological state of an Experiencer, as in *Wo3 hen3 fan2* 'I very annoy' (I am very annoyed). As a causative verb, it indicates an event or state of affairs that brings about this state in a patient, as in *Ni3 bie2 fan2 wo3* 'You not annoy me' (don't annoy me).

2.8.6 Morphological constraints

As discussed in sections 2.5 and 2.6, the creation of a grammatical DVC or RVC is subject to several morphosyntactic constraints as well as to the semantic constraints just discussed. For the sake of completeness, I state these more explicitly here: (1) DVCs allow two or maximally three verbs to be combined, and RVCs allow only two component verbs; (2) RVCs disallow reduplicated verbs (e.g., *gan1-gan1-jin4-jin4* 'be.clean-be.clean') in the V_2 slot; (3) the V_2 of an RVC cannot be modified by degree modifiers.

2.9 Summary

This chapter has discussed the typological features of the way Mandarin encodes spontaneous and caused motion and state change with DVCs and RVCs. In the semantic domain of motion, DVCs pose a challenge for the classification of Mandarin as a "satellite-framed language" because their components are all full verbs (e.g., Slobin, 2004) and Mandarin children's descriptions of motion events show features of both satellite-framed languages and verb-framed languages (L. Chen, 2005). To further explain the typological features of DVCs and RVCs, I have described in detail their compositional and semantic properties. I show that the creation of DVCs and RVCs is a highly productive process, but one that is subject to a number of constraints on the semantic and morphosyntactic properties of the V_1 and V_2, and their combination. Now with a clear picture of the constrained productivity of DVCs and RVCs in adult language, we are ready to examine how children become productive in verb compounding. The next chapter (Chapter 3) will discuss the notion of productivity in child language, review studies of the acquisition of complex predicates, and explicate the theoretical framework adopted in this dissertation. Chapters 4 to 7 will then present the empirical studies that investigate the acquisition of verb compounding from the perspective of production, comprehension, event encoding and categorization, and argument structure.

PRODUCTIVITY IN THE ACQUISITION OF COMPLEX PREDICATES

CHAPTER 3

3.1 Introduction

Productivity is one of the central characteristics of human language. It is demonstrated in the ability of native speakers to create and understand grammatical and communicatively appropriate expressions that they have never heard before. All normally-developing children end up with adult-like productivity in their language. Recognition of the importance of this phenomenon was central to the rise of non-behavioristic, "cognitive" approaches to language acquisition in the late 1950s and early 1960's (Chomsky, 1959).

To achieve productivity, children must identify the semantic and formal building blocks of their language, and discover the rules for extending these to novel referents and for combining them into new but acceptable configurations. For example, to use the English plural suffix -*s* productively, children must analyze plural forms such as *dogs* into their root form plus a suffix, figure out what types of words the suffix can be attached to, determine what its semantic effect will be, and choose its correct allomorph based on the phonology of the root. To create a novel noun compound like *plant-man* (i.e., gardener), children must first break down conventional compounds like *fireman* and *mailman* into their lexical components and establish how these components are ordered so that they can create new forms cut to the same pattern. To use a word productively for referents to which they have never heard it applied, children must understand that it is not a name for a single object, event, or relationship, but rather picks out a whole category of referents – a category governed by a concept that the learner must identify.

In this chapter I discuss aspects of productivity that, in broad crosslinguistic perspective, are relevant to the mastery of complex predicates in a language like Mandarin. Complex predicates are usually used to refer to events and other complex situations in which there are many elements that could potentially be encoded. Languages differ in the choices speakers must routinely make about which components to actually encode, where and how to encode them, and how to sequence elements. For example, speakers of Mandarin must often combine two predicates in a compound verb to express information for which speakers of another language would typically use a single verb. So complex predicates can serve as a lens through which to look closely at how children gain productive control of the characteristic ways their target language structures meaning.

In §3.2 I examine hypotheses about the cognitive bases for productivity in learning the mapping between meanings and forms. In §3.3 I review studies of the acquisition of complex predicates such as English verb-particle combinations (e.g., *walk in, break apart*). These are similar to Mandarin DVCs and RVCs in that all these constructions are typically used to encode events of motion and state change. I leave review of the few relevant studies of the acquisition of compound verbs in Mandarin to Chapter 4, where I will also report on my own findings. In §3.4 I discuss theoretical approaches to productivity in the acquisition of complex predicates.

3.2 Productivity and form-meaning mapping from a crosslinguistic perspective

Since languages vary systematically in how they encode meanings (e.g., Talmy, 1985, 2000), achieving productivity in one's native language entails acquiring language-specific patterns of semantic organization. An important theoretical question is whether children embark on this process from a shared starting point; in particular, whether they start out by mapping forms to a uniform set of meanings, or whether they tune in to language-specific form-meaning mappings from the very beginning.

Important advances have been made in our understanding of this question over the last 35 years (see the discussion in Bowerman, 2000). Three hypotheses have been very influential: the Cognition hypothesis, as christened by Cromer (1974) and drawn on by Slobin in his Operating Principles approach to crosslinguistic work on language acquisition; Basic Child Grammar (Slobin, 1985), and Typological Bootstrapping (Slobin, 1997a, 2000).

The Cognition hypothesis, which originated and spread rapidly during the 1970's, proposed that the meanings expressed by language are established in the child independently of language and reflect universal principles of cognitive development. One line of evidence was that children's first word combinations such as – in English – *there ball, more cookie,* and *Mommy go*, seem in all languages to revolve around the same set of basic relational concepts, such as agency, action, location, possession, and the existence, recurrence, non-existence, and disappearance of objects (Bowerman, 1973; R. Brown, 1973; Slobin, 1970, 1973). To explain this tendency, R. Brown (1973) invoked Piaget's (1954, 1971) work on children's early conceptual development. Piaget had argued that during the sensorimotor period of development, from birth to about two years, children construct basic notions of space, causality, and the enduring object. When language starts to come in, it maps to these meanings that the child already knows. Conceptual development was seen, then, as a critical precursor to linguistic development, in the sense that it provided, by hypothesis, the concepts to which the forms of language are mapped.

In related work of the early 1970s, Slobin (1973) built the tenets of the Cognition hypothesis into his Operating Principles approach to language acquisition. If early cognitive development is uniform across children, suggested Slobin, we can assume that the semantic notions underlying language emerge at about the same time and in the same order for children everywhere. But languages express these same meanings in different ways; for example, English uses word order to distinguish who does what to who, whereas Turkish uses case endings on the nominals. By examining the relative time at which alternative devices for expressing the same meaning emerge, we can discover children's predispositions for mapping meanings to form. Slobin formalized his hypotheses about these predispositions as "Operating Principles" (worded as self-instructions for learners), e.g., "Avoid interruption or rearrangement of linguistic units" and "Underlying semantic relations should be marked overtly and clearly".

In a later extension of the Operating Principles approach, Slobin (1985) incorporated a stronger claim about the kinds of meanings to which children initially orient. According to Talmy (2000), the meanings of grammatical morphemes are highly constrained. Open-class forms can mean almost anything, but closed-class grammatical morphemes such as inflections and prepositions are much more restricted; by hypothesis, they are constrained by biases that are built into the language-learning child. Combining this hypothesis about grammatical morphemes with his own evidence for the universal "Operating Principles" children follow in acquiring a first language, Slobin proposed that the outcome of children's first efforts to learn the mappings between forms and meanings is a universally specifiable "Basic Child Grammar".

By the 1990's, new crosslinguistic research had begun to question the assumption that language acquisition sets off from a cognitively and semantically uniform starting point, and to suggest that acquisition is in fact influenced from the very beginning by language-specific principles of semantic organization. The evidence revolved around the early expression of motion and spatial relations, long thought to be meanings strongly guided by nonlinguistic cognition (e.g., Johnston & Slobin, 1979). In earlier work, Talmy (1985, 1991) had shown that language differ systematically in their characteristic way of expressing motion, and he had proposed a two-way semantic typology that distinguished between "satellite-framed" languages and "verb-framed" languages (cf. Chapter 2). In one important set of studies, Bowerman and Choi (e.g., 2001, 2003; Choi & Bowerman, 1991) compared the acquisition of expressions of motion by children learning a satellite-framed language, English, and a verb-framed language, Korean.

English characteristically expresses Path with particles such as *up, down, in, out,* and *past*, combined with an intransitive or a transitive verb that expresses Manner, Cause, or Deixis (see §2.2). In contrast, Korean expresses Path in the verb, and its Path verbs are strictly either intransitive (for spontaneous motion) or transitive (for caused motion). The Path meanings in English and Korean also differ, and to some extent crosscut each other: e.g., the category picked out by the Korean transitive verb *kkita* 'put into a tight fit relation' crosscuts the fundamental "containment" (*put in*) and "contact/support" (*put on*) distinction made by English *put in* vs. *put on,* while the English "containment" category (*put in*) crosscuts the Korean "tight fit" category (*kkita*).

Bowerman and her colleagues found that children's earliest expressions of motion in these two languages are structured according to language-specific semantic and grammatical principles, and there is little evidence that learners have strong prelinguistic biases for classifying space differently from the way introduced by their language. For example, learners of English quickly show facility with the makeup of verb-particle constructions, grasping how to break up complex events into an action, encoded in the verb, and a change of location or state, encoded in a particle like *up, down, in, out, on,* or *off*, which remains constant regardless of whether the motion is spontaneous or caused. Korean children, in contrast, at first encode either an action or a Path, but not both at once, and they distinguish strictly in their Path expressions between spontaneous motion (intransitive verbs) and caused motion (transitive verbs).

Learners of the two languages also conform to language-specific categories of Path very early: e.g., Korean-speaking children are sensitive to the distinction between tight-fit (interlocking) relationships vs. various kinds of loose-fit relations, whereas English-speaking children are sensitive to the contrast between containment and support. This is significant because concepts like “containment” and “support” had long been assumed to be basic to both human spatial cognition and language-learning children (e.g., Johnston & Slobin, 1979), yet children exposed to Korean show no tendency to rely on them. These findings show that children display language-specific patterns of “event packaging” essentially from their earliest language production. As Bowerman (1985: 1285) put it, “children are prepared from the beginning to accept linguistic guidance as to which distinctions – from among the set of distinctions that are salient to them – they should rely on in organizing particular domains of meaning”.

The finding of pervasive language specificity in early language development is echoed in crosslinguistic investigations of the expression of motion in children’s narratives (e.g., Berman & Slobin, 1994; Hendriks, 1993, 2005; Hickmann, 2003; Hickmann & Hendriks, 2005). For example, Berman and Slobin (1994) found that from at least age three, learners of verb-framed languages (Spanish, Hebrew, and Turkish) and satellite-framed languages (English and German) differ systematically in how they talk about motion in telling the *Frog Story* (see footnote 10 in §2.2). Speakers of satellite-framed languages provide detailed within-clause descriptions of Paths within a clause (e.g., *the deer threw them off over a cliff into the water*); and they also tend to specify Manner (e.g., *crawl, swoop, tumble,* etc.) and Cause (*dump, hurl, shove,* etc.). Speakers of verb-framed languages, in contrast, provide less detailed descriptions of Path and Manner, but are often more elaborate in describing the locations of protagonists and objects and of the endstates of motion.

To accommodate the growing evidence that children orient very early to the typological properties of the input language, Slobin (1997a, 2000) has proposed the concept of Typological Bootstrapping. According to this hypothesis, children begin very early, on the basis of what they have already learned, to develop expectations about how information will be encoded in their language – e.g., at what level of granularity and in what part of speech. For example, as children learn some initial constructions describing motion events, they begin to expect that Paths will be lexicalized in the verb stem (in a verb-framed language) or in a satellite (in a satellite-framed language); the initial grammar comes to organize itself along the lines of the underlying typology.[28] The outcome of Typological Bootstrapping is an individual who has learned to analyze events and attend to dimensions of experience in a language-specific way. This language-induced tuning of attention to those aspects of situations that one's language routinely encodes has been labeled "Thinking for speaking" by Slobin (1996). According to the theorizing embodied in the notions of Typological Bootstrapping and Thinking for Speaking, linguistic forms do not, after all, simply map directly onto a stock of prelinguistic concepts, as researchers, including Slobin himself, had previously believed. Instead, the concepts that learners use in speaking and understanding are gradually shaped by the semantic and grammatical categories of the language being learned.[29]

3.3 Productivity and the acquisition of complex predicates

Complex predicates are usually used to encode events and other situations. Events are complicated and have many potential components, so languages have to make choices about which components to actually encode and where and how to encode them. By investigating the acquisition of complex predicates we can determine more closely how children master the characteristic ways their language structures meaning. In §3.2 we have already looked at some relevant issues, such as the distribution of information about motion events in Korean and English (e.g., Bowerman & Choi, 1991) and in Frog story studies (Berman & Slobin, 1994). Here I will discuss studies focused more specifically on complex predicates as such.

The notion of "complex predicate" is rather general and covers a number of constructions. Of particular interest to us are the constructions typically used to encode events of motion and state change in English and other Germanic languages. In English, these constructions often involve the combination of a verb and a particle or an adjectival complement, as in *He ran in* (e.g., into the woods) (spontaneous motion), *He sneezed the foam off* (e.g., off his cappuccino) (caused motion), and *She wiped the table clean* (resultatives) (Goldberg, 1995; Goldberg, Casenhiser, & Sethuraman, 2004). In German, they

[28] A second example of Typological Bootstrapping comes from studies of the acquisition of the meanings of everyday verbs in Mayan languages. Mayan verbs of motion, eating, cutting, breaking, holding, and so on specify events at a high degree of granularity: they are specific to objects of certain types (e.g., P. Brown, 2001; de León, 2001). For example, to answer a question about what she is eating, a speaker of Tzeltal Maya must chose between verbs like *k'uk* for crunchy solids or beans, *lo'* for soft solids like fruits, *ti'* for meat, and *we'* for grain-based foods (P. Brown, 2001). Mayan children tune in early to this fine breakdown of events, and use the verbs in an appropriately specific way from the beginning.

[29] The Thinking for Speaking hypothesis is compatible with the Whorfian claim that the categories of one's language influence nonlinguistic cognition, but it does not entail this; it is also compatible with the view that language affects thinking *only* in the context of producing or understanding language, but not otherwise.

often involve particle verbs such as *aufmachen* 'make open' and *erschiessen* 'shoot dead'.[30] These constructions resemble Mandarin verb compounds in two respects: (1) in form they are compositional since they consist of two parts, a verb and a free standing particle or an inseparable prefix; and (2) in meaning they may or may not be compositional, since the combinations vary in their degree of semantic transparency.

Behrens (1998) investigated the acquisition of complex predicates in learners of three closely related Germanic languages, English, German, and Dutch. Drawing on longitudinal corpora from ten children from the age of 1;2 to 4;0, she looked for verb-particle constructions, particle verbs, verb-plus-preposition combinations (e.g., *look at*), and prefix verbs. She found that learners of all three languages produced verb-particle combinations frequently and productively from about age two. Productivity was shown by the flexible combination of particles with a variety of verb stems, and of verb stems with a variety of particles, with some verb stems occurring in combination with more than twenty different particles.

Behrens' learners also showed construction-specific learning: all the children adhered initially to one particular construction frame (e.g., verb-particle combinations or verb-preposition combinations), and acquired other structural possibilities only later. The result of this construction-specific learning was that complex predicate types were distributed differently across the different groups of language learners. For example, a case study focused on the verb *look* in English and *gucken* 'look' in German showed that although Naomi, a learner of English, and Simone, a learner of German, both acquired particle-verb constructions and simplex verb+PP constructions, they learned them in a different order and produced them with different relative frequencies: Naomi mastered PP constructions first and particle-verb constructions only later, while Simone mastered particle-verb constructions first and PPs rather late. These differences mirrored differences in the relative frequency with which these two kinds of constructions are used in child-directed speech in the two languages.

In research on two learners of English, Bowerman (1982a, 1988a, 1988b) examined the children's acquisition of verb-particle combinations expressing caused motion and state change, and also of reversative *un-* prefixation (as in *uncover*), a construction that expresses

[30] There has been debate about how to analyze such constructions in Germanic languages; in particular, whether they are best understood as involving lexical processes (i.e., as complex verbs, e.g., Broihier, Hyams, Johnson, Pesetsky, Poeppel, Schaffer, & Wexler, 1994) or as syntactic processes (i.e., as small clauses, e.g., Bennis, den Dikken, Jordens, Powers, & Weissenborn, 1995). In this dissertation nothing hinges on this decision.

the reversal of a state change. She found that the children at first produced bare particles such as *up* or *down* to describe a wide range of spontaneous and caused motion events, but by age two they combined them frequently with a variety of manner or cause verbs to form complex predicates such as *walk in, run out, put down, pull out,* and *pull off.* They also used verb-particle combinations to express caused state changes, e.g., *eat all gone, wipe table clean,* and *pull open.* Bowerman (1982a: 329) suggested that although there is productivity at this two-year-old stage, it is still limited compared to what it will become:

> Sentences containing common combinations of verb plus effect (e.g., *push* [or *pull*] plus *in* [or *out, up, down, over*]; *eat* plus *all gone*) begin to occur in good number when a child is as young as 2 years. It is conceivable that the child learns each combination on an example-by-example basis; it is more likely, however, that some generalization takes place such that the child can guess, even in the absence of confirming input, that if *push* can take *down/off/in* and so on and *pull* can take *down* and *off*, *pull* can also probably take *in.*

After about a year and a half of producing mostly conventional combinations, learners begin to make novel combinations (Bowerman, 1982a, 1988c), for example, **I pulled it unstapled* (3;8, after pulling a stapled book apart, cf. *pull apart*), **Are you washing me blind?* (5;6, as mother wiped corners of her eyes, cf. *wash clean*), and **…whenever I breathe, I breathe them down* (6;2, trying to set up a village of paper houses, cf. *blow down*). With reversative *un*-prefixation, a similar sequence was observed: first a period of producing conventional *un*-prefixed verbs like *uncover* and *untie*; later the onset of innovative combinations like **unstraight* (=bend), **unshorten* (=lengthen), **unhate* (=stop hating), **uncapture* (=release) and **untight* (=loosen).

Bowerman describes the steps that lead to a full flowering of productivity in complex predicates in terms of reorganization in the learner's grammar. In prior research, reorganization had been invoked to explain why errors with irregular inflectional forms are often preceded by use of the correct form, e.g., *feet* before *foots* and *went* before *goed.* But as Bowerman showed, the notion can also be applied to children's acquisition of complex predicates. According to her account, forms that to adults have a complex internal structure – that is, consist of subunits with independent combinatorial potential, such as *push down* or *wipe clean* – can be used correctly by language learners before they are (implicitly) aware of this structure. For the learner, the forms are initially independent of one another, or at best understood as related at a low level of abstraction (e.g., *push/pull* plus a directional particle). Over time, the forms become integrated under a single, more abstract schema: the child can now disregard the specific semantic contributions of the individual lexical items and see what all the combinations have in common – that the main verbs all specify an action that causes an entity to undergo a change, and the particles or other complements all specify the nature of this change, i.e., the resulting locative or attributive state. Once this semantic abstraction is attained and has been linked to a certain constructional pattern, "the child is in a position to make an infinite number of novel combinations", including errors (Bowerman, 1982a: 330).

There are subtle constraints in English on permissible combinations of verbs and particles (e.g., resultative constructions), and verbs plus the reversative *un*-prefix. This is why children who have formulated an abstract schema can produce errors. For example, English resultative constructions exclude past participles as the result complements (Green, 1972), and also present participles (e.g., *He polished his shoe shiny/*shined/*shining*). Reversative *un*-prefixed verbs may not combine with a particle (cf. *tie it on/*untie it off*) (Bowerman, 1982a) (combinations like this may be ruled out by the more general *Unique Path* constraint [cf. §2.8.2] since both *off* and *un-* specify a result, but not the same result). Other difficult-to-pin-down constraints rule out combinations like **hammer the metal round* and **wipe the table dirty.* Many of children's errors with *un-* prefixation, as Bowerman (1982a) discusses, involve violations of the "cryptotype", or covert category, associated with the base verbs in conventional verbs prefixed with reversative *un-*: the base verbs all have a "centripetal" meaning, that is, a "covering, enclosing, or surface-attaching meaning" (Whorf, 1956), as in *untie, unbuckle, uncoil, unfasten*. Examples of children's violations of this cryptotype include **unstraight* (for bending wire) and **unhate.*

The mastery of subtle semantic constraints on English resultative construction takes a long time: errors like *Untie it off*, *The doggie bited him untied* (bit [the rope] such that he was untied), and *Don't cut me bald* (cut my hair so that I am bald) did not fade out until about age nine in Bowerman's data (Bowerman, 1982a; 1988c, p.c.). The child's learning problem is, then, not only to analyze a form (whether a complex word or a larger construction) into its constituent parts, but also – a more difficult problem – to figure out the morphological, syntactic, and semantic constraints on possible combinations. "Covert" semantic categories pose particular learning challenges for children (Bowerman, 1982a).

To summarize, the studies reviewed in this section show that children learning different languages use complex predicates productively from an early age. Learners of English use verb-particle combinations to describe motion and state-change events by the age of two or before, and they begin to make overgeneralization errors after they have used these constructions correctly for about a year and a half. This learning has been described as involving reorganization (Bowerman, 1988) – children integrate forms previously learned and used independently of each other under a common rule, which gives rise to overproductivity. To constrain this overproductivity and arrive at the adult state, children have to learn subtle semantic constraints on the combinations.

3.4 Making and constraining generalizations: Theoretical approaches

In what follows, I will review three theoretical approaches that are relevant to the acquisition of complex predicates. The first two are nativist in flavor, i.e., they rely on knowledge of language structure that is inborn. The third, the usage-based approach, which I will adopt, stresses learning.

3.4.1 The Compounding Parameter

A specific nativist account has been proposed to account for the acquisition of complex predicates, *the Compounding Parameter* (Snyder, 1995, 2001). This proposal falls within the principles-and-parameters approach to language acquisition (e.g., Chomsky, 1981; Chomsky & Lasnik, 1993; Roeper & Williams, 1987). This approach assumes that children are born with knowledge of linguistic universals (principles) and of clusters of linguistic properties with a limited number of "settings" (parameters) which capture major dimensions of variation across languages. A parameter is "set" in the language learner on the basis of clear triggers in the linguistic input, and this setting may in turn trigger the acquisition of a set of related grammatical structures.

According to the proposed Compounding Parameter, languages permit complex predicate constructions like particle verbs, resultatives, and double objects if and only if they productively allow the formation of N-N compounds (Snyder, 1995). A strong correlation has been found between the age at which children become productive with N-N compounding and the age at which they acquire complex predicate constructions, which has been taken as support for the role of this parameter in language acquisition (Snyder, 1995, 2001; Stromswold & Snyder, 1997). Acquisition data in Japanese also appears to be consistent with the parameter (Miyoshi, 1999).

It is not clear whether this account is correct, e.g., whether all languages obey the Compounding Parameter or whether the acquisition of complex predicate constructions always goes hand-in-hand with the acquisition of N-N compounding. But even if this is the case, the parameter does not address the problems that I am most concerned with. It tries to explain how the child is in a position to produce compounds and complex predicates at all, but it is not concerned with, e.g., the constraints on VCs in Mandarin and how the child acquire them, the semantic division of labor between the verbs in a VC, and the argument structure of a VC. For help with these issues, we need to look elsewhere.

3.4.2 Broad- and narrow-range rules and constrained productivity

Recall that not every combination of verbs forms a legitimate VC in Mandarin (see §2.8), e.g., you cannot describe a situation in which someone hits someone else, causing him to jump, with the compound **da3-tiao4* 'hit-jump'. Do children have the tendency to overgeneralize? If so, how do they end up with their productivity appropriately constrained? There is no current theoretical account of this, but an analogous problem has been tackled by Pinker (1984, 1989): how children achieve constrained productivity with English argument structure alternations.

Learners of English often apply argument structure alternations to verbs that do not undergo them, producing odd-sounding sentences like **Don't fall me down* (the causative-inchoative alternation: cf. *John broke the cup* vs. *The cup broke*) and **Can I fill some salt into the bear?* [a bear-shaped salt cellar] (Bowerman, 1982a, 1988c) (the locative alternation: cf. *Mary sprayed paint on the wall* vs. *Mary sprayed the wall with paint*). Assuming there is little negative feedback in the linguistic input, how do children identify these verbs as nonalternators? Part of the solution, proposes Pinker (1989), is to understand argument structure alternations as operations that derive verbs with one kind of meaning from verbs with another kind of meaning. These operations are constrained by two different kinds of rules.

The *broad-range rule* for an alternation relates two "thematic cores", which are conflations of semantic elements that define a kind of possible verb meaning: e.g., for the causative alternation, one thematic core has the form "Y <+dynamic> event: ACT/GO (e.g., *The ball rolled*) and the other has the form "X ACT on Y, thereby CAUSing Y ACT/GO" (e.g., *John rolled the ball*). The broad-range rule provides a first-pass filter on an alternation by limiting the alternation to verbs that can be represented in terms of both thematic cores: e.g., to be causativized, Y must specify a dynamic event, not a state. And the broad-range rule also indicates what a new verb, which can be derived by running the rule in either direction, would mean. But certain verbs do not alternate even though they satisfy the requirements of the broad-range rule, e.g., English *fall* and *giggle* are dynamic, but they cannot be causativized. To deal with this, Pinker proposes a finer level of constraints, in which each broad-range rules is paired with one or more *narrow-range rules* that specify which, out of all the semantic classes of verbs that are compatible with the broad-range rule and so in principle could alternate, are the semantic classes that actually *do* alternate. For the causative alternation, for example, alternating classes include verbs of "externally-caused change of physical state" (*melt, break,* etc.) and verbs of "motion taking place in a certain manner" (*roll, bounce,* etc.).

In acquisition, posits Pinker, the broad-range rule for an alternation and its associated narrow-range rules are built up simultaneously: the broad-range rule is a broad schematic generalization over instances of the alternation observed in the input, and the associated narrow-range rules are generated by a hypothesized learning mechanism that generalizes only out to the boundaries of each semantic class for which an alternation has been observed. The result is a grammar that is correct from the beginning. Critically, children's errors with argument structure alternations are due not to faulty or overly general rules, but to performance errors or misconceptions about the meaning of a verb – e.g., the child temporarily understands the verb as having a meaning compatible with a semantic class that has been observed to alternate.

To insure correct learning with these procedures, Pinker must build a fair amount of innate machinery into the child. For example, to acquire the broad-range rules children must have foreknowledge of the appropriate linking between syntactic positions and the semantic elements in the (decompositional) semantic representation of a verb's meaning (e.g., first argument of CAUSE [agent] links to subject position, second argument [affected object] links to object position). Children must also know that the kind of causation specified in the broad-range rule for the causative-inchoative alternation is *direct* (by hypothesis this is the default reading of "ACT on"). This directness requirement blocks English verbs like *cry* and *bloom* from causativizing (cf. **You cried me; *Water bloomed these flowers*), since they specify internally-caused events (Levin & Rappaport Hovav, 1995), where the properties or emotions of the "causee" mediate between the cause and the effect. Children must also come equipped with sensitivity to the semantic distinctions that should guide generalization: the privilege of alternating must generalize unerringly only to verbs in the same semantic class as those that have been observed to alternate.

Although it has not yet been attempted, Pinker's theory could conceivably be worked out to account for constraints on Mandarin verb compounding: e.g., semantic subclasses of verbs do seem to be relevant to which novel compounds are acceptable and which are considered strange (see §2.8). But Mandarin verb compounding is more complicated than the argument structure cases for which Pinker's theory was designed. As discussed in Chapter 2, verb compounding represents a highly productive way to encode motion and state change. In acquiring this system, learners must figure out not only the meaning of individual verbs, along with their argument structures, but also the relationship between the meanings of the component verbs and the meaning of the compound as a whole. It is unclear how knowledge of the meanings of component verbs can predict the meaning and argument structure of the verb compounds they appear in. A further problem is that many everyday resultative verb compounds in Mandarin violate the supposedly universal principle enshrined in the broad-range rule with which Pinker constrains the English causative-inchoative alternation – that causativization must be *direct*; a case in point is *qi4-ku1* 'anger-cry' (anger, thereby causing to cry) or *chui1-lü4* 'blow-green' (as in *chun1feng1 chui1-lü4 le liu3shu4* 'spring breeze blow-green willows' [willows turn green/revitalize due to the spring weather]).

In summary, neither the principles-and-parameters approach nor Pinker's nativist account invoking broad- and narrow-range rules seems to adequately address the specific learning problems associated with Mandarin verb compounding. In what follows, I will discuss the major claims of the usage-based learning approach, and examine whether it provides a plausible account for the problems associated with learning verb compounds.

3.4.3 The usage-based approach to language acquisition

The usage-based approach to language structure and language acquisition is a bottom-up approach that emphasizes the speaker's continual exposure to language in context, with emphasis on the relative frequency of forms and on general cognitive mechanisms such as schema formation, analogy, activation, entrenchment, and pre-emption (e.g., Bybee, 1985; Goldberg, 1995; Goldberg, Casenhiser, & Sethuraman, 2004; McClure, Pine, & Lieven, 2006; Tomasello, 2000a, 2000b; Wittek & Tomasello, 2002). An important line of theorizing within the usage-based approach is that of Construction Grammar (e.g., Brugman, 1988; Croft, 2001; Fillmore, Kay, & O'Connor, 1988; Goldberg, 1995).

Constructions

According to Construction grammar, constructions are the basic units of grammar. These are conventionalized symbolic unit pairing form and meaning, and they include all grammatical assemblies in a language – i.e., all idiosyncratic, semi-productive, and regular expressions (cf. Fillmore, Kay, & O'Connor, 1988; Goldberg, 1995). Grammatical categories such as words, phrases (including idiomatic expressions), and sentences are constructions on a continuum of varied productivity. So productivity reflects an interaction between the component(s) of a construction and the semantics and morphosyntax of the construction – for verb constructions, the construction itself constrains the class of verbs that can be integrated with it (Goldberg, 1995). Productivity in language therefore entails acquiring knowledge of both the semantics and syntax of the constructions as well as the various constraints associated with them.

Goldberg (1995) has studied how the productivity of argument structure constructions is constrained. Of particular relevance to us are the *caused motion* construction (e.g., *John sneezed the napkin off the table*) and the *resultative* construction (e.g., *I brushed my hair smooth*), which are often used to encode events of motion and state change in English. These two types of constructions are quite analogous to Mandarin DVCs and RVCs. The verb with a directional PP or a resultative phrase (e.g., particle or adjective) forms a complex predicate, but not all verbs can appear in such complex predicate constructions in English.

Let us look at the caused motion construction, for example. The basic sense of this construction (i.e., the constructional meaning) is that a causer or agent directly causes a theme (i.e., Figure, in Talmy's [2000] terminology) to move to a new location. Verbs such as *sneeze* do not in themselves encode a motion, but they can appear in the caused motion construction, as in *sneeze the napkin off the table*, because the composition of *sneeze* with the PP indicating the Path is compatible with the basic sense of the *caused motion* construction. Goldberg (1995) has proposed a number of semantic constraints to account for why some verbs are not allowed in this construction, such as the direct causation constraint (e.g., **John encouraged her into the room*) and the *Unique Path* constraint (**Harry shot Sally across the room*) (see §2.8.2).

The same logic applies to explaining the constrained productivity of English resultative constructions. These constructions entail a causer or agent directly causing a theme to undergo a change of state. Verbs that can appear in a resultative construction do not necessarily in themselves encode an external cause. For example, the verb *roar* cannot be used directly as a causative verb (e.g., **The lion tamer roared the lion*), but it is felicitous to say *He roared himself hoarse*. This is interpreted as showing that the construction itself is associated with a particular argument structure configuration, and candidate verbs must be able to integrate with the constructional meaning this defines.

Learning constructions

The most important proposition in the usage-based learning approach to language is that language structure – both historically and ontogenetically – emerges from language use (e.g., Tomasello, 2000b). This means that children begin their language learning with concrete and specific linguistic constructions, and create abstractions only gradually through repeated acts of language comprehension and production. Consistent with this argument, Goldberg (1995) proposes that arriving at a grasp of which verb can participate in which argument structure constructions involves implicit generalizations over learned instances. The usage-based learning approach to learning, unlike the nativist account, does not assume that children come equipped with innate grammatical knowledge such as the innate linking rules as proposed by Pinker's theory.

Tomasello (1992) has provided evidence for usage-based learning in a longitudinal study of his daughter's verb development. He found that this child initially used each verb in only one type of sentence frame (e.g., *cut X; X get-it*). To account for the idiosyncratic syntactic behavior of early verbs, Tomasello proposed the Verb Island hypothesis, which states that each verb in a child's language repertoire initially forms its own "island" of organization. Children's early grammars comprise an inventory of verb islands, with word combinations based on lexically specific argument roles (e.g., for the verb *draw*: the 'drawer', 'thing drawn', and 'thing drawn with'), rather than on abstract syntactic or semantic categories and relationships such as subject, object, or instrument. The Verb Island hypothesis has been supported by a number of further studies of English-learning children's verb development (e.g., Lieven, Pine, & Baldwin, 1997; McClure, Pine, & Lieven, 2006; Tomasello & Brooks, 1998), as well as by studies of children learning languages other than English (e.g., Italian, Portuguese) (see Tomasello, 2000a, for a review).

How do children proceed from verb island constructions to productivity? The usage-based approach to language learning accounts for productivity by reference to children's gradual induction of constructional schemas. Constructional schemas are like grammatical rules in that they describe the general properties of linguistic structures; they are patterns involving variables (or "placeholders") that can be filled by certain types of elements. In the early stages of language learning, children mostly use language in the way they have heard adults using it. Their early combinations are unanalyzed holophrases, e.g., *thank you*, and item-based constructional schemas, with perhaps some open slots in them built up through observed type variation in that position in the utterance, as in *X allgone* and *more X.*

Constructional schemas allow children to create novel expressions, making language a flexible tool. Achieving greater productivity is seen as a continuous development (Tomasello, 2000b).

Two important factors that contribute to the process of becoming productive are analogical learning and type frequency effects. Children make constructional analogies on the basis of joint similarities of form and function. For example, at a certain stage children may discover that the English verbs *give, send, show* – previously treated separately as "verb islands" – both share a "transfer" meaning and the structure NP+V+NP+NP. This analogical abstraction would allow them to use other verbs with a "transfer" meaning in the same construction. Type frequency has to do with the number of different combinations in which some expression or some element of an expression has been experienced: the more types, the greater a speaker's likelihood of generalizing to yet another type.

A further question concerning productivity is how children recover if they become too productive with constructions (e.g., **I'm patting her wet; *You cried me*). There is a fundamental difference between Pinker's nativist account (see §3.4.2) and the usage-based learning approach. For Pinker, the child's (argument structure) generalizations are by hypothesis properly constrained from the very beginning, so there is no need to explain how she retreats from overgeneralizations in the absence of negative evidence. Pinker attributes children's errors in argument structure to either performance slips or erroneous verb meanings. But this account has been criticized on grounds that there is little evidence for the proposed innate linking rules, that children seem to lack sufficient sensitivity to the narrow-range rules proposed for the causative alternation, and that children produce far more causativization errors over a longer period of time than is compatible with the notion that these errors are simply performance slips or due to incorrect verb meanings (see Bowerman & Croft, 2007 for a critical review).

The usage-based learning approach, in contrast to Pinker's approach, assumes that the child is likely to make abstractions that are at first too broad; later, as attested exemplars accumulate that instantiate certain kinds of meanings and not others, the child develops subschemas for these meaning clusters. A number of general psychological mechanisms have been proposed to play an important role in constraining overproductivity. Two mechanisms are particularly relevant here: *pre-emption* and *entrenchment* (see Bowerman & Croft, 2007 for discussion). In pre-emption, repeatedly hearing conventionalized form-meaning mappings in adult speech eventually overrides the child's erroneous forms: e.g., hearing *kill* often enough as the causative of *die* will eventually lead the child to say, e.g., *I killed it*, rather than **I died it.* In entrenchment, hearing a form always in a construction of one kind and not another – e.g., *die* always in an intransitive frame and never in a transitive frame – will eventually suppress the child's tendency to use the form in the unattested construction.

Recent studies have shown a role for pre-emption and entrenchment in explaining how children cut back on certain argument structure overgeneralizations (e.g., Ambridge, Pine, Rowland, & Young, 2008; Braine & Brooks, 1995; Brooks, Tomasello, Lewis, & Dodson, 1999; Pine, Ambridge, & Rowland, 2007; Theakston, 2003). But the power of these mechanisms against two-part overgeneralization like **I pulled it unstapled, *I'm patting her wet,* and **Untie it off* is dubious (Bowerman, 1996a). If children eliminate such errors simply by repeatedly registering which complements have been heard with which verb, and using only these attested combinations, all productivity would eventually cease. Yet the combination of verbs with locative and resultative complements is highly productive. Bowerman (1996a) suggests that retreating from these kinds of errors involves the child's discovery of the subtle semantic and morphological constraints governing the combination of verb and complements (as discussed in §3.3).

Although Bowerman's (1982a) chapter was written before the Construction Grammar approach to argument structure came on the scene, she clearly treats the acquisition of English resultative constructions as a gradual constructional process. Children are seen as initially learning conventional resultatives (e.g., *eat X allgone, wipe X clean*) in a piecemeal fashion and only later coming to reorganize them under a more abstract schema that comprises a main verb indicating the cause and a complement (particle or adjective) indicating a state or location change. Knowledge of this schema gives rise to a sudden flood of innovative combinations (e.g., 4;0: *I'm patting her wet* [patting sister's arm after dipping hand into water]; 4;9: *I'll jump that down* [about to jump on bathmat mother has just put on top of the water in a bathtub; see also §3.3). With still further experience with language, children gradually induce the subtle semantic and sometimes morphosyntactic constraints on combinations – for example, that the result complements cannot be participles.

Writing specifically about early word formation, Clark (1993) proposes a related but more comprehensive usage-based account of how children gradually fine-tune their productive rules so that they can innovate while still respecting constraints on what is possible. She points out that novel noun compounds show up across children learning different languages. For example, children learning English produce novel noun compounds from as young as about age 1;6, e.g., *sky-car* (airplane), and *crow-bird* (crow) (1;7).

Innovative uses of a noun as a verb appear at about the age of two, e.g., **Mummy trousers me* (put my trousers on) (2;3), **I'm sanding it* (2;4.13) (putting sand on it), and **Don't hair me* (resisting having his hair brushed) (2;4). Clark suggests that children's innovative word formations stem from their lack of knowledge of the conventional form–meaning mappings in adult language. The relative productivity of different word formation devices in adult speech reflects the collective conventional preferences of the speakers of a language. These preferences interact with word structure, frequency, norms, and function, and mirror speakers' current perceptions of the meaning-form mapping relations possible and available for use in coining new words. Children start out not knowing what is conventional and what is innovative in meaning-form mappings within the language. Only gradually do they analyze those elements that occur and recur in many different constructions. To acquire adult preferences in generating new constructions, children have to analyze many constructions. In this way they gradually set up the conventional constructions of their language.

In summary, the usage-based approach to learning specifies that achieving an appropriately constrained productivity in language acquisition is a gradual process. Children start out in a piecemeal fashion by picking up specific constructions from the input, and only later induce more abstract schemas that allow them to create novel combinations. Both analogical learning and the relative frequency of occurrence of constructions of various sorts, and of type-frequencies within a construction, plays an important role in freeing children from their initial verb-island constructions. Language learning is thus seen as an inductive process.

The basic tenets of the usage-based learning approach provide a useful theoretical framework for my study of children's acquisition of verb compounding since they address all the questions I am concerned with, e.g., how do children become productive with combining verbs to form conventional verb compound constructions and when do they discover the constraints on this process? The acquisition of DVCs and RVCs provide a testing ground for understanding these processes.

3.5 Summary

This chapter has discussed the notion of productivity in language acquisition, and especially in the acquisition of complex predicates. A core issue in accounting for productivity is to understand how children acquire a feel for the target language's characteristic patterns of mapping between forms and meanings. Studies in cognitive linguistics and semantic typology have shown that languages vary systematically in their categorization and encoding of events.

Crosslinguistic studies of children's early semantic development suggest that – contrary to long-held beliefs – it is unlikely that children initially map forms directly to prelinguistic concepts; rather, their mapping is language-specific from the very beginning of production. Much of the relevant evidence comes from the domain of motion event encoding (Bowerman, 1989, 1994; Choi & Bowerman, 1991; Slobin, 1997b, 2004) and complex predicates used in descriptions of events of motion and state change (e.g., Behrens, 1998; Bowerman, 1982b, 1988b).

To reach adult productivity in the expression of motion and state change, learners of Mandarin must accomplish tasks analogous to the learning of complex predicates in English, German, and Dutch. Just as speakers of Germanic languages must learn how to combine verbs with particles and other complements, speakers of Mandarin must discover the characteristic lexicalization patterns by which verbs are combined with other verbs. In acquiring patterns of verb compounding, children need to identify which meaning components are usually expressed by the first verb and which by the second (or third) verb. They also need to identify the subtle semantic constraints on allowable combinations of verbs. We will examine these two requirements in the next chapter.

BECOMING PRODUCTIVE IN MANDARIN VERB COMPOUNDING

CHAPTER 4[31]

4.1 Introduction

This chapter investigates the development of verb compounding by Mandarin-speaking children. The major questions addressed include: When do children begin to use VCs productively? What is the relationship between the use of VCs in their speech and in the adult input? When do they learn the constraints on creating new VCs? Section 4.2 starts the chapter off by reviewing the most relevant studies of the acquisition of compounds in Mandarin and in the closely-related language Cantonese. Only a few studies have addressed these issues systematically, but they provide some insights into the learning process. To address questions of productivity, I have analyzed both spontaneous and elicited speech data. Section 4.3 draws on spontaneous speech data from two longitudinal corpora to outline the course of development in learning DVCs and RVCs. Section 4.4 presents three elicitation studies, the first two exploring the use of DVCs and RVCs in children's elicited descriptions of motion events and state-change events, and the third focusing on children's knowledge of constraints on verb compounding. Section 4.5 summarizes and discusses the findings, and draws some conclusions about the learning process.

4.2 Early production of verb compounds in Mandarin and Cantonese

Mandarin-speaking children have been observed to make innovative compounding errors from an early age. Chao (1968), one of the earliest researchers to study Mandarin children's

[31] Part of this chapter has been published as Chen, J. (2006) The acquisition of verb compounding in Mandarin. In E. V. Clark & B. F. Kelly (Eds.), *Constructions in acquisition* (pp. 111-136). Stanford, CA: CSLI.

language development, noted in his diary study of his Mandarin-speaking granddaughter Canta that compounding errors started as early as 28 months. For example, Canta created innovative but odd nominal compounds like *di4-shui3* 'ground-water', meaning 'river, lake, and pond', and *huo3-deng1* 'fire-light', meaning 'lighted candle'. She also made outright errors in verb compounding at this age, separating the two verbs of a compound with an intervening NP, as in *Chi1 fan4 wan2 le* 'eat rice finish PFV' (I finished eating), where she mistakenly used *chi* 'eat' and *wan* 'finish' as two full verbs rather than combining them into the verb compound *chi1-wan2*.

Several more recent studies have also made interesting observations about Mandarin-speaking children's acquisition of verbs and related constructions. Erbaugh (1978, 1982, 1992) conducted comprehensive work on the lexical, syntactic, and semantic development of four Taiwanese children learning Mandarin: LH (2;0 to 2;2), ZR (2;7 to 2;9), Pang (1;9 to 2;11), and Kang (2;10 to 3;9). She found that resultative complement forms (i.e., RVCs) were relatively rare between age 2;0 and 2;9, but became quite frequent from 2;10 to 3;6. The children made many types of errors, including the following:

a. Creation of anomalous RVCs such as *peng4-fang4* 'bump-put' (to describe an unsuccessful attempt to pop a balloon). Such verb compounds are difficult to interpret and do not seem to encode the intended causal semantic relations. In the event described with *peng4-fang4*, the action of bumping does not lead to the (re)location (putting) of something. Rather the intended meaning might be described with a conventional VC such as *peng4-po4* 'bump-be.broken'.

b. Combination of too many verbs, such as the addition of redundant directional or resultative elements, for example:

(46)	Pang (2;4):	*Zhe4*	*ge*	*po4-diao4-xia4-qu4-lai2*	*le*	*ye!*		
		This	CLF	be.broken-fall-descend-go-come	PFV	SFP		
		(Sticking her hand in the slot where a drawer has been removed from a chest.)						

(47)	Pang (2;11):	*Gei3*	*na4me*	*duo1*	*huai4*	*ren2*	*da3-si3-diao4*	*le.*
		Make	so	many	bad	person	hit-die-fall	PFV
		(Talking about killing demons with her toy sword.)						

The errors in (b) involve combining more than two verbs (for RVCs) or three verbs (for DVCs). Note that the verb *diao4* 'fall' (off, away) can express a meaning of moving off or away from a source-location or source-state; it is frequently associated with irrevocable change or completion, as in *huai4-diao4* 'be.broken-off' (be broken) and *si3-diao4* 'die-off' (die). Erbaugh suggested that children's errors of overcombination such as the overuse of *diao4* in (46) and (47) reveal a tendency to emphasize the caused state change. The ill-formed compounds *po4-diao4-xia4-qu4-lai2* 'be.broken-fall-descend-go-come' and *da3-si3-diao4* 'hit-die-fall' correspond to conventional compounds in adult usage: *po4-diao4* 'be.broken-fall' and *da3-si3* 'hit-die'.

c. Omission of an action/process verb in descriptions of causal events. Children sometimes use a single result verb alone, omitting the first verb of an RVC:

(48) ZH (2;8): **Bu2 huai4.*[32]
Not be.broken
'Don't break it.'
(Meaning *Bu2 yao4* ***nong4-huai4*** 'Don't make-break it' (don't break it).)

**Ma1ma huai4 ta1.*
Mummy be.broken it
'Mummy be broken it.'
(Meaning *ma1ma* ***nong4-huai4*** *ta1* 'Mummy make-be.broken it' (Mummy broke it).)

**Wo3 hui4 po4-diao4.*
I will be.broken-fall
'I will be broken (it) off.'
(Meaning *Wo3 hui4* ***da3-po4*** *zhe4 ge* 'I will hit-be.broken this' (I will break this).)

**Wo3 chu1-lai2 le.*
I exit-come PFV
'I exit-come (it).'
(Meaning *Wo3 dao4-chu1-lai2 le* 'I pour-exit-come' (I poured something out).)

(49) Kang (2;10): **Wo3 yao4 gao1 zhe4 ge.*
I want tall this CLF
'I want to tall this.' (Building block tower, wants it taller.)

---

[32] Verbs like *huai4* only denote states (here, being broken, bad or malfunctioning), and can only be used intransitively. When they combine with the perfective aspect marker *-le* they get an inchoative dynamic reading, e.g., *huan4 le* 'be.bad LE' (It went bad).

**Mian4bao1 zen3me ban4 de?*
Bread how halve DE
'How come the bread became into halves?'
(Cutting clay bread in half.)

(50) Pang (2;10): **Wo3 xi3huan1 sui4.*
I like be.in.pieces
'I like be (things) in pieces.'

(Meaning *wo3 xi3huan1* ***nong4-sui4*** *dong1xi* 'I like make-be.in.pieces things' (I like to smash things).)

As shown by the examples above, the omission of an action/process verb leads to an ungrammatical use of an intransitive verb as a causative, i.e., a causativization error. Erbaugh noted that ungrammatical causative uses of intransitive verbs are very common among the children she studied. Errors like these are unlikely to occur in the input, since adults routinely use RVCs such as *nong4-huai4* 'make-be.broken' and *nong4-gao1* 'make-be.tall' to express a caused change of state or location. It seems that it takes time for children to understand that the preferred method of causativization in Mandarin is verb compounding.

Causativization errors have been observed in learners of a variety of languages (see Pye & Loeb, 1998, for a review). For instance, children learning English produce causative errors such as **Don't fall me down* and **Don't giggle me* (e.g., Bowerman, 1988c; Clark, 1993). English, unlike Mandarin, has a wide range of verbs that can be used both intransitively and as transitive-causatives, e.g., *break* in *The cup broke* and *John broke the cup.* Part of the learning task for English-speaking children, therefore, involves figuring out which verbs can causativize, and also which cannot. In Hebrew, another language unrelated to Mandarin, children also overgeneralize certain morphological rules of causativization and produce verb forms that have no adult models (Berman, 1985). Thai resembles Mandarin in employing verb compounding to express causation. Yumitani (1998) found that children learning Thai make causativization errors similar to the examples in (48) to (50), omitting the first verb of a compound. He noted that Thai children not only causativize but also decausativize, i.e., use transitive-causative verbs as intransitives, although there are more errors of the former type. These studies suggest that there are some early similarities in learning causative alternations among children acquiring different languages, although eventually children must learn a language-specific strategy. The study of the acquisition of verb compounding (in particular, RVCs) is relevant to determining when and how children become sensitive to a language-specific method of encoding causation.

Another researcher who has recently discussed the acquisition of verb compounds is H.-T. Cheung (1992). Cheung studied the acquisition of the BA construction by monolingual Mandarin-speaking children in Taiwan. The relevance of the BA construction to verb compounding is that this construction occurs most often with complex predicates such as RVCs. Analyzing longitudinal data from 10 children (7 months to 6 years of age), Cheung found that the children began to produce BA constructions at the age of 2, and that the correct production of the BA construction correlates with correct uses of RVCs. He suggested that learning the BA construction might have triggered children's analysis of verb compounds, but he did not explore the learning of verb compounds further. Cheung also observed semantically inappropriate uses of verb compounds by children, such as *pen1-jin4* 'spray-enter' (spray in) in a context where a conventional RVC, *pen1-shang4* 'spray-ascend (spray-on)', should have been used (for describing an event where paint was sprayed on the surface of the box). Cheung suggested that a comprehensive study of children's acquisition of verb compounds is needed.

Cantonese also has a productive system of verb compounding, although its combinatorial properties differ somewhat from those of Mandarin. S.-L. Cheung (1998) studied Cantonese-speaking children's acquisition of resultative verb compounds – compound causatives or resultative verbs, in her terminology – and locative constructions. In an analysis of longitudinal data from eight children from 1;4 to 3;8, she found that the children began to use RVCs productively from as early as 1;8 (productive in the sense that neither the cause nor the result verb had been modeled in the two utterances immediately preceding the child's utterance). All the RVCs produced were well-formed, and children used them correctly as causatives. Semantic overextensions occurred by around 2;3; for example, one child overextended *saan1-maai4* 'close-finish' (close, for doors/windows) to closing a book, where *kam2-maai4* 'close-finish' (close, for books) should have been used. Across all the verb compounds produced by these children, *laan6* 'be.broken/torn' was the most frequently used result verb (V_2). At around 2;4, the children began to combine this verb with a variety of different action verbs.

Taken together, these studies show that the production of verb compounds begins early, at about 2 years of age, with novel combinations emerging by about 3 years but with children having problems figuring out the combinatorial possibilities of verbs. But such observations are sporadic, and do not give a comprehensive picture of how this productive process develops. It also remains unclear whether and how children learn constraints on the possible combinations of verbs. In the following sections, I discuss Mandarin data from naturalistic corpora and elicitation studies with these questions in mind.

4.3 Verb compounds in the longitudinal spontaneous speech corpora

When do Mandarin children begin to use VCs productively? That is, when do they come to understand that VCs are compositional, and begin to combine simple verbs to create VCs that they have not heard in the input? Further, what is the relationship between children's use of VCs and that of adults, and how do learners progress in their use of VCs beyond the early stages? To answer these questions, I analyzed the data in the Fang corpus (Min, 1994) and the Beijing Mandarin corpus in the CHILDES archive (MacWhinney, 2000; Tardif, 1993). The Fang corpus comprises longitudinal data from five children whose age varied at the start of data collection, as did the length of the periods they were observed for. Across all the children, the age range is from 0;11.28 to 3;5.28. The Beijing Mandarin corpus (henceforth simply the Beijing corpus) comprises data from 10 children recorded from age 1;9 to 2;2.

4.3.1 Description of the Fang corpus and the Beijing corpus

The Fang corpus and the Beijing corpus have some features in common. For example, both data sets were collected in Beijing at around the same time, the late 1980s and the early 1990s, the data were mostly collected in natural situations at the target child's home, and the sessions all involved multiple adult caregivers interacting with the child, as is typical for Chinese children of their age.

The Fang corpus

Each child in the Fang corpus was visited and audio-taped at home in Beijing once a week or once every other week from 1983 to 1987. Contextual notes were also made at each visit. Each session lasted about 30 minutes and was conducted in the living room, with a few exceptions when the child asked to go outside. The child's grandmother was usually present during the sessions, and sometimes his or her parents, too. The adults were asked to simply do what they usually did with the child. Table 4.1 shows the gender and ages of the five children at the beginning and end of the recording sessions, as well as the number of months they were followed.

Table 4.1. Gender, age, and duration of data collection for the five children in the Fang corpus

Child	Gender	Age (start)	Age (end)	Duration of data collection (in months)
Mengmeng (MDY)	F	1;01;12	3;5;28	28
Dandan (DAN)	F	0;11;28	1;10;22	11
Maliang (MLI)	M	1;8;11	2;3;10	7
Jiajia (JIA)	F	2;6:8	2;10;13	4
Duanlian (LIA)	F	3;1;20	3;5;04	5

For convenience, I will refer to each child by the abbreviation of his or her name. The child MDY's mother was a research assistant and her father a librarian. The family lived together with her grandmother, who took care of her during the day before she went to nursery school. Her grandmother was frequently present during the data sessions. Her mother was also sometimes present, her father rarely. DAN's parents had just started a small business shortly before the first visit. The family lived with the child's grandparents, who took care of her during the day. In the data sessions her grandmother and her mother were always present and her father rarely. MLI is the only male subject in the corpus. His father was a taxi driver and his mother worked in a laboratory. He was cared for by a female neighbor of his grandmother's age, whom he called "granny". JIA was taken care of by her grandmother during the day, and her parents were only occasionally present during the data sessions. She had many toys and children's picture books. LIA lived with only her parents, but she went to see her grandparents regularly during the weekends, and the data collection was done there. She also went to kindergarten every day. All five children were involved in activities typical for a Chinese family: playing with toys, reading books, learning to name family members and to count, naming known objects in pictures as the adult told the story, and so on.

In the present study, I selected a subset of files from each child's corpus. File selection was based on two criteria: (1) The child had to be at least 1;3 at the time of the first file selected, by which age we could expect utterances of one word or longer; (2) There should not be intervals of more than a month between files, although an exception had to be made for MDY and DAN, since there were quite a few gaps in the data collection. The selected files are listed in Appendix 4.1. There were 52 files in total, 16 sessions from MDY and 9 each from each of the other children.

The Beijing corpus

The data in the Beijing corpus were audio-taped by Twila Tardif (1993) from 10 families in Beijing between August 1991 and January 1992. Tardif was interested in comparing the language development of children from different family backgrounds, so she purposely selected the 10 families on the basis of the social-educational level of the parents: 5 families represented a "workers" group (both parents had received formal schooling below high school level) and 5 represented an "intellectuals" group (both parents had received formal schooling at high school level or above, such as college or graduate school). The ages and genders of the participants in the two groups were equated. All the parents of the target children were native speakers of Mandarin, and all the children were firstborn and only children. The mean age of the children was 21 months, 24 days at the time of the first visit, and the average length of data collection was 4 to 5 months.

Table 4.2. Gender, age, social class, and duration of data collection for the children in the Beijing corpus

Child	Gender	Social class	Duration of data collection by age (start-finish)
BB	M	Intellectual	1;10.12 – 2;2.7
CXX	F	Worker	1;09.25 – 2;1.18
HY	M	Intellectual	1;09.10 – 2;1.4
LC	M	Worker	1;09.21 – 2;1.9
LL	M	Worker	1;09.6 – 2;0.27
LXB	F	Intellectual	1;09.3 – 2;1.9
TT	M	Worker	1;09.3 – 2;0.28
WW	M	Worker	1;10.28 – 2;3.2
WX	M	Intellectual	1;09.27 – 2;1.20
YY	M	Intellectual	1;10.20 – 2;2.18

As in the Fang corpus, the caregivers of the children included not only their parents, but also their grandparents or great-grandparents, live-in nannies, aunts who came to the house every day for lunch or dinner, neighbors, and any adult who intervened in the child's activities. The visits were spaced about two weeks apart, and the families were asked to do whatever they usually did at that time of day. The specific activities that the families engaged in varied, but included the range considered "normal" in China for an urban two-year-old child and his or her caregiver(s): indoor toy play, watching television, cleaning up, eating, talking and playing with neighbors, and a trip to a local amusement park. In all cases, Tardif asked the families not to interact with her during the recording time and to try to ignore her presence as she stayed off to the side taking notes on the context of the interactions. In practice, interactions between the researcher and the family members occurred frequently, particularly towards the end of the study when she was a familiar presence not only to the children and their families but also to their immediate neighbors. In total, there are 50 sessions in this corpus, 5 for each child.

Transcription

All the utterances of both the target child and the adults in the Fang corpus and the Beijing corpus, as well as information about the context, were transcribed in the Pinyin[33] format and checked by native Mandarin speakers (Min, 1994; Tardif, 1993). The Pinyin transcripts are in a format compatible with CHAT (i.e., Codes for the Human Analysis of Transcripts), the standard transcription system for CHILDES (MacWhinney, 2000). A CHAT-formatted data file consists of a main tier for the spontaneous utterances of the child and the adults, and one or more dependent tiers below the main tier which may be specified according to the researcher's purpose; they typically contain codes, comments, and other information of interest (see §4.3.2 for examples).

Mean length of children's utterances

Mean Length of Utterance (MLU) has been widely used in language acquisition studies around the world (see, e.g., R. Brown, 1973, for English). This measure has been argued to be a valid and useful tool for Mandarin as well (H.-T. Cheung, 1998), and it has been used in major studies of the acquisition of Mandarin (Erbaugh, 1978, 1982, 1992a; Tardif, 1993; Min, 1994). To establish and compare the children's overall morphological and syntactic development, I also used MLU as a measurement. Using the CLAN (Computerized Language ANalysis) program (MacWhinney, 2000), I calculated the child's MLU in each file on the basis of the child's full set of utterances. This information is listed in Appendices 4.1 and 4.2, together with the age, vocabulary size (in morpheme and number of utterances), and standard deviation (SD) of the MLU of each child.

The MLUs of the five children in the Fang corpus and the ten children in the Beijing corpus increase overall with age. In the same age ranges their MLUs are quite comparable, both within and between corpora. For example, by the age of about 1;3, DAN and MDY in the Fang corpus, from whom the earliest data are available, have entered the one-word stage, and by around 1;10 their MLUs have reached about 2. At 1;4 to 1;7, DAN, MDY, and LIA have similar MLUs – all between 1.61 and 1.99. Between the ages of 1;9 to 2;2, MDY, DAN, and MLA show an overall MLU of 2.45 (range 1.95 to 3.0), very close to the average MLUs of the children (who are also within this age range) in the Beijing corpus (cf. Appendix 4.1). So I assume that the children in the two corpora are comparable at similar ages, and that the

[33] Pinyin is the official system used in P. R. China to transcribe Mandarin into the Roman alphabet.

children sampled in both corpora are representative of Mandarin-speaking children in general.

4.3.2 Coding

To analyze the development of VCs, I coded all the utterances in the data selected from the Fang and the Beijing corpora. The coding tier, termed the MOR tier (morphological tier), is a dependent tier of the main utterance tier that gives information about the part of speech of the words in the utterance.

The MOR tier could be created with two methods: by manually coding the part of speech word by word, or by using the MOR program in CLAN to code automatically. The latter method was used because it had two obvious advantages – consistency and efficiency in coding. To enable the MOR program to code automatically requires a set of grammar files (command scripts that tell the program to identify words and link the codes and the words) and a lexicon file that includes information about the part of speech of the words (MacWhinney, 2000: 110-111).[34] With these files in place, the MOR program was applied in the following four steps to create the MOR tiers:

a. Creating a lexicon: The MOR command (mor +t* +xl *.cha) in the CLAN program (MacWhinney, 2000) was used to extract all the words produced by all the speakers in all the selected files in the two corpora.

b. Category coding: The part of speech of the monomorphemic verbs and verb compounds in the extracted lexicon were coded manually according to the categories shown in Table 4.3. The coded lexicon was used by the MOR program to automatically code all the utterances in the corpus.

c. Creating the coding tier: The MOR command (mor +t* *.cha) was used to generate a dependent MOR tier that gives the parts of speech of the words in each utterance.

d. Checking the coding: The coded files (which now had a MOR tier under the main tier of each utterance) were checked in order to disambiguate homophones and correct misspellings in the original transcripts that may have resulted in coding errors.

---

[34] I thank Romuald Skiba for his invaluable help in creating the Mandarin grammar files.

Table 4.3. Codes and coding categories for the longitudinal spontaneous speech corpora

(Note: See Chapter 2 for discussion of subcategories of DVCs and RVCs.)

CODES	CODING CATEGORIES	EXAMPLES	Glosses
DIRV	Directional verb	*shang2*	'ascend'
DVC	Directional verb compound	*zou3-jin4*	'walk-enter' (walk in)
DVC-ASP	Directional verb compound with directional complement verb marking aspect	*ku1-qi3-lai2*	'cry-rise-come' (begin to cry)
DVC-MET	Directional verb compound with metaphorical use of complement verbs	*shuo1-chu1-lai2*	'speak-exit-come' (speak out)
DVC-BU	Negative potential form of directional verb compound (with infix *bu* 'not')	*xia4-bu-lai2*	'descend-not-come' (cannot come down)
DVC-DE	Positive potential form of directional verb compound (with infix *de* 'able')	*xia4-de-lai2*	'descend-able-come' (can come down)
RVCS	Resultative verb compound indicating physical or mental state change	*da3-kai1* *re3-nao3*	'hit-open' (open) 'pester-be.annoyed'
RVCS-DE	Positive potential form of resultative verb compound indicating physical or mental state change with infix *de* 'able'	*da3-de-kai1*	'hit-able-open' (can open or can be opened)
RVCS-BU	Negative potential form of resultative verb compound indicating physical or mental state change with infix *bu* 'not'	*da3-bu-kai1*	'hit-not-open' (cannot open or cannot be opened)
RVCC	Completive resultative verb compound	*chi1-wan2*	'eat-finish'
RVCC-DE	Positive potential form of completive resultative verb compound with infix *de* 'able'	*chi1-de-wan2*	'eat-able-finish' (can eat up)
RVCC-BU	Negative potential form of completive resultative verb compound with infix *bu* 'not'	*chi1-bu-wan2*	'eat-not-finish' (cannot eat up)
VI	Intransitive verb	*shui4*	'sleep'
VT	Transitive verb	*reng1*	'throw'

The following two excerpts from the child MDY at 3;2.3 give an idea of what a coded file looks like. According to the CHAT convention, the main tiers, e.g., *MDY (the target child), and *RUI (the data collector), are marked with an asterisk (*), and the dependent tiers are marked with a percentage symbol, as in %mor (the morphological tier) and %sit (the situation tier). The %sit tier, created by the one of the original data collectors, R. Min, describes the context (situation) of the utterance. The vertical line is conventionally used to separate the code and the actual morpheme or word in CLAN. Codes for lexical items other than verbs and verb compounds were also included in the %mor tier, but not systematically, since they were not analyzed in the current study. There was no post hoc checking of these categories, which include, for example, SFP (sentence final particle), ADJ (adjective), N (noun), ADV (adverb), and ASP (aspect marker). See ABBREVIATIONS (p. xi) for specifications. English translations are added here in square brackets [Lit:…] for reader convenience; they are not in the original transcripts.

EXCERPT 1:

*MDY: xiao3 ji1 dou1 chu1-lai2 le.

%mor: ADJ|xiao3 N|ji1 ADV|dou1 DVC|chu1-lai2 ASP|le.

%sit: In the picture book the little chickens were born and come out of the eggs.

[Lit: Little chickens all exit-come *le* = All chickens have come out (of the eggs)]

*RUI: xiao3 ji1 cong2 nar3 chu1-lai2 le ya.
%mor: ADJ|xiao3 N|ji1 PREP|cong2 WH|nar3 DVC|chu1-lai2 ASP|le SFP|ya.
[Lit: Little chicken from where exit-come *le* question-particle = From where did the chicken come out?]

EXCERPT 2:
*MDY: zhe4 dou1 jiang3-wan2 le.
%mor: PRON|zhe4 ADV|dou1 RVCC|jiang3-wan2 ASP|le.
[Lit: This all talk-finish = (I) have finished telling this.]

*RUI: zhe4-me guai1.
%mor: ADV|zhe4-me ADJ|guai1.
[Lit: So good = (You) have been so good.]

*RUI: wo3 dou1 mei2 ting1-qing1chu3.
%mor: PRON|wo3 ADV|dou1 NEG|mei2 RVCS|ting1-qing1chu3.
[Lit: I all not listen-clear = I did not hear (you) clearly at all.]

*RUI: hai2 mei2 ting1-dong3 ne.
%mor: ADV|hai2 NEG|mei2 RVCS|ting1-dong3 SFP|ne.
[Lit: Still not listen-understand SFP = (I) didn't understand (you).]

After coding the data, I analyzed them using programs in the CLAN program (MacWhinney, 2000), including FREQ (FREQuency search), KWAL (Key Word And Line), and COMBO (COMBinatiOn search) to extract and collate all the utterances containing VCs.

4.3.3 Results

Let us first examine the use of verb compounds (VCs) by the children in the Fang corpus. Recall that the Fang corpus has data from children from 1;3 to 3;5 years of age. In total, the five children produced 129 VC types and 310 tokens (type/token ratio 0.416). These VCs include both DVCs and RVCs. The type frequencies of VCs, broken down by child and age, are shown in Figure 4.1.

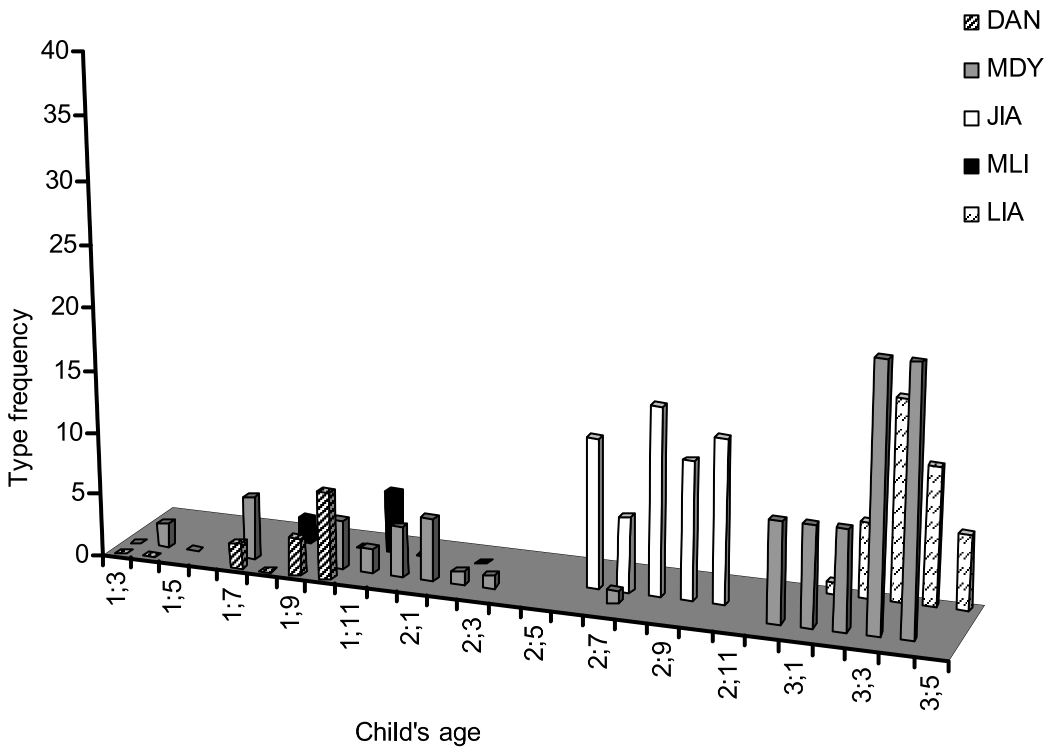


Figure 4.1. Type frequencies of VCs in the Fang corpus, by child and age

This figure shows a clear increase with age in the use of VCs. The earliest production of VCs begins at about 1;4 (for the child MDY) and 1;7 (for the child DAN). There is a gradual increase in the number of VCs from around 1;9 on. VCs seem to blossom at around 2;6, as suggested by the many types and tokens of VCs from JIA (indicated by the white bars). It is unclear whether the other child, MDY, from whom we have data from 1;4 to 3;5, also used VCs frequently from 2;6, since data from her are missing between 2;8 and 2;11. But in the next available period, 2;11 to 3;1, MDY seems to produce a similar number of VCs as JIA at 2;6 to 2;11. Given the many types of VCs produced, these data suggest that from age 2 children might have some sensitivity to the compositionality of VCs and by around 2;6 they might be able to form new VCs freely.

But how general is this development pattern? Is it mirrored the children in the Beijing corpus? How productive are they in using VCs? The ten children in the Beijing corpus range in age from 1;9 to 2;1. Their overall VC type/token ratio for DVCs and RVCs combined is 0.32 (89/282). Given that each child produced only a small number of VCs in the samples for each month, I have collapsed each child's data across the five-month period. Figure 4.2 shows the frequency of VC types from each child in this period.

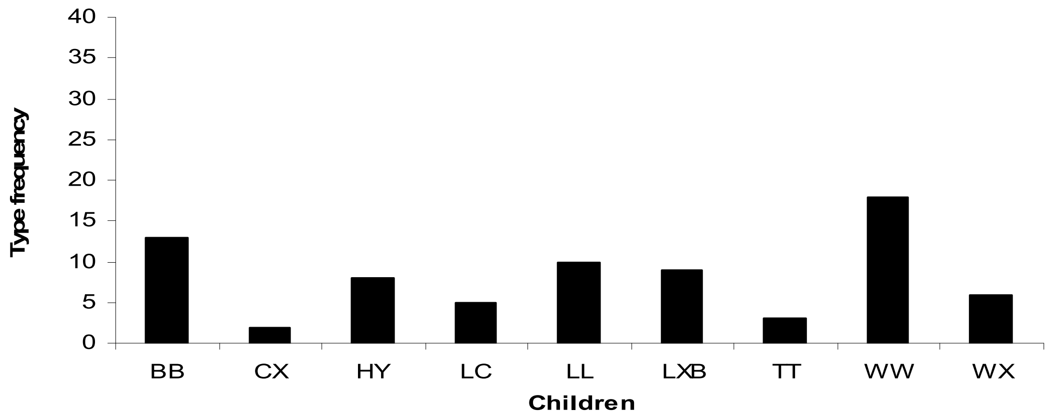


Figure 4.2. Type frequencies of VCs in the Beijing corpus by child
(data from 1;9 – 2;1 collapsed)

These children, like MDY and MLI in the Fang corpus, produced a number of different VC types by around 1;9 to 2;1, with a range from 2 to 18 (note that these numbers represent each child's overall uses of VCs across five months). VC types for each month range from 0 to 3, which seems comparable to the range in the speech of MDY and MLI (0 to 6, cf. Figure 4.1). The limited number of VC types before age 2 in both corpora suggests that the earliest VCs are probably unanalyzed chunks that children pick up from the input.

To understand the nature of the earliest uses of VCs, I further examined DAN and MDY, for whom there are data from the very beginning of VC production, 1;4 to 2 years. DAN's earliest adult-like VCs emerge at age 1;7, and her overall type/token ratio for verb compounds is 0.56 (19/34). MDY first used VCs at around 1;4, and her overall type/token ration is 0.76 (13/17). Here are two examples:

(51) DAN (1;10.22): *Da3-kai1!*
Hit-open
'Open (it).' (The child wants her mother to open a toy.)

(52) MDY (1;7.09): *Chi1-wan2 le.*
Eat-finish PFV
'I finished eating.'

The earliest VCs used by DAN and MDY are similar in many ways. Most of their VCs occurred only once in the data sampled, and these VCs are generally bare, as in examples (51) and (52): very rarely do they include even one argument. Adult models of these VCs can often be found in the immediate context, usually in the preceding question from the adult to the child, as in (53):

(53) *MOT: *Shui2* ***nong4-huai4*** *le?*
Who **make-be.broken** PFV
'Who made this break down?'
*DAN: *Xiao3 Dan1* ***nong4-huai4***.
Little Dan **make-*be.broken***
'Little Dan broke this.'

These early uses closely follow the adult models – the 19 VC types in DAN's speech and the 17 types in MDY's speech are subsets of the 85 types and 79 types in their respective input.

To summarize, these data suggest that Mandarin children are able to produce VCs from as young as 1;4 – 1;7, and there is a continual growth in their use of VCs, with a rapid increase at around 2;6 and beyond. Before age 2;1 there is little evidence that children have analyzed VCs into their components and can create VCs that they have never heard before.

Do children use VCs productively beyond age 2;1? In the two corpora, there are only three children from whom data are available beyond the age of two, all from the Fang corpus: MDY, JIA, and MLI. Since the data from MLI stop at 2;3, I focus on MDY and JIA in this analysis. Let us first look at the data from MDY from 2;2 to 3;5.

The overall type/token ratio of MDY's VCs is 0.53 (74/140) during this age period, as compared to 0.49 (102/208) in her input. MDY's caregivers produced a variety of VC types, and MDY herself showed productivity in verb compounding, producing many VCs that were not found in her input – 42% (31 out of 74 different VCs) did not appear in the adult speech sample. Table 4.4 shows some of her VCs: those in bold were not in the adult sample. Of course, any VC that is not in the adult sample might have been produced by a caregiver at some other time.

Table 4.4. Examples of VCs by MDY from 2;2 to 3;5

Verb shared	VCs	Glosses	Tokens	Age
si3 'be.dead' (V_2)	***du2-si3***	'poison-be.dead' (poison to death)	2	3;3
	sha1-si3	'kill-be.dead' (kill)	1	3;4
	qie1-si3	'cut-be.dead' (cut to death)	1	3;3
wan2 'finish' (V_2)	***nong4-wan2***	'do-finish' (finish doing)	1	3;2
	wanr2-wan2	'play-finish' (finish playing)	1	3;4
	chi1-wan2	'eat-finish' (finish eating)	2	3;4
	chang4-wan2	'sing-finish' (finish singing)	2	3;4
	zuo4-wan2	'do-finish' (finish doing)	1	3;3
	lu4-wan2	'record-finish' (finish recording)	1	3;4
	jiang3-wan2	'talk-finish (finish talking)	1	3;2
kai1 'be.open' (V_2)	*kai1-kai1*	'open-open' (open)[35]	6	3;0
	da3-kai1	'hit-open' (open)	10	2;2
qi3-lai2 'rise-come' (V_2)	***jiao4-qi3-lai2***	'shout-rise-come' (begin to shout)	1	3;3
	zhan4-qi3-lai2	'stand-rise-come' (stand up)	1	3;3
	chui1-qi3-lai2	'inflate-rise-come' (blow up)	1	3;2
chu1-lai2 'exit-come' (V_2V_3)	***tiao4-chu1-lai2***	'jump-exit-come' (jump out)	1	3;2
Song4 'send' (V_1)	***song4-hui2***	'send-return' (send back)	2	3;4
	song4-dao4	'send-arrive' (send-to)	2	3;4

As suggested by the examples in Table 4.4, MDY showed a certain feel for the combinatorial nature of verb compounds in this age range: she had learned that there are two or three verb slots in a compound, and she produced a variety of verbs in all these slots, e.g., *nong4-wan2* 'make-finish', *sha1-si3* 'kill-die', and *tui1-dao3* 'push-fall'. Different slots were associated with different sets of verbs, e.g., *nong4-wan2* 'make-finish' and *wanr2-wan2* 'play-finish'. MDY also produced three-verb compounds (9 types) such as *zhan4-qi3-lai2* 'stand-rise-come'. Some of her three-verb DVCs had Path verbs expressing the trajectory of the motion, and some DVCs also had Path verbs with an abstract aspectual meaning, e.g., *jiao4-qi3-lai2* 'shout-rise-come (begin to shout). Further evidence that MDY had analyzed the composition of VCs is that she correctly produced their potential forms by inserting the potential infix *-bu-* 'not' between the component verbs in *da3-bu-kai1* 'hit-not-open' (cannot open) (2 tokens, age 3;2), *kai1-bu-kai1* 'open-not-open' (cannot open) (1 token, age 3;2), and *na2-bu-zhao2* 'take-not-be.on.target' (cannot reach) (2 tokens, age 2;2).

But MDY's productivity was still probably quite limited. Most of her VCs that were not in the input occurred only once or twice, not until around age 3;2 or older. And they often

---

35 *Kai1-kai1* 'open-open' is a conventional RVC, often used colloquially to describe an opening event. It cannot be interpreted as a simple reduplicative verbal phrase of the same verb *kai1* because its meaning differs from that of a typical reduplicated verb phrase like *kan4-kan4* 'look-look' (take a look), or *ting1-ting1* 'listen-listen'. The more precise glosses for the two verbs *kai1-kai1* seem to be'do.opening-be.opened'. It seems that *kai1* has two different senses, *kai1*$_1$ 'do an opening action' and *kai1*$_2$ 'be in an open state'. These two senses are reflected in the RVC *kai1-kai1*. Further research is needed to explore the semantics of *kai1*.

revolved around a small fixed set of "pivot"-like verbs used as V_1 or V_2 in combination with different verbs: 3 new VCs with *si3* 'be.dead' (V_2), 2 with *wan2* 'finish' (V_2), 3 with *qi3-lai2* 'rise-come', and 2 with *song4* 'send' (V_1) (see Table 4.4). Only some of these component verbs were also used alone, for example, *wan2* 'finish' (2 tokens, at 3;3 and 3;4), and *song4* 'send' (1 token, at 3;4). MDY seemed to create new VCs by holding one verb constant and filling the other verb slot with different verbs.

What is the relationship between MDY's use of VCs and the VCs in her input? Let us compare the two sets of VC types. Both MDY and her caregivers produced DVCs more frequently than other subcategories of VCs, followed by RVCCs (RVCs indicating the completion of the action denoted by V_1) and RVCSs (RVCs indicating a physical or mental state change). Overall there is a close correspondence in the frequencies of the different categories of VCs in the speech of MDY and the adults, as shown in Figure 4.3.

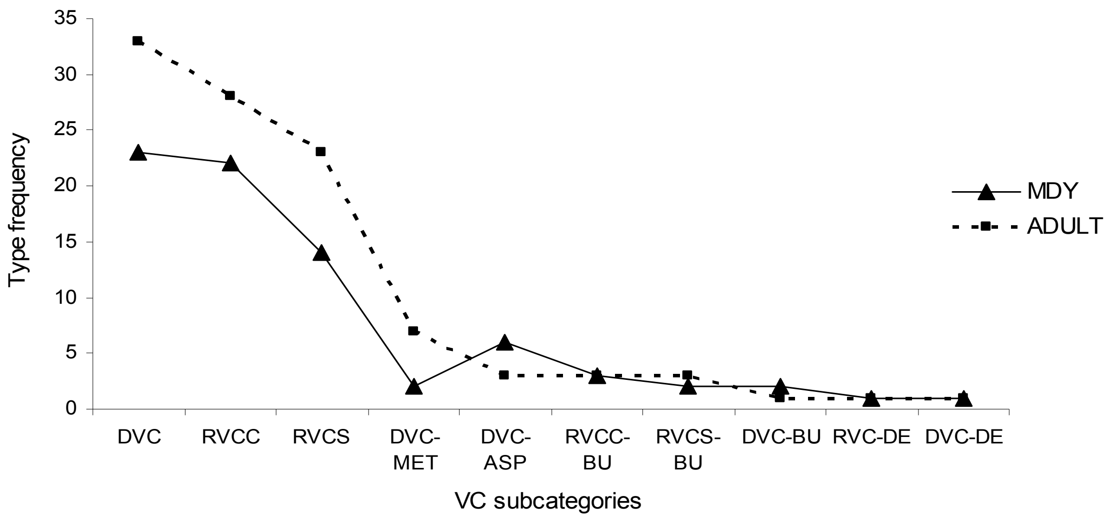


Figure 4.3. Type frequencies of VC subcategories in the speech of MDY and her caregivers

This close correspondence of construction frequencies in the speech of children and their caregivers has been observed in the literature: "frequencies in child speech, within the limits of the child's competence, tend to match adult frequencies" (R. Brown, 1973:143); and "children's utterances usually follow the surface structure pattern modeled most frequently in adult speech" (Bowerman, 1973:174). Recent studies of children's verb learning also suggest that children are very sensitive to their mothers' use of the verbs (Choi, 1999; De Villiers, 1985; Naigles & Hoff-Ginsberg, 1998). The use of VCs by MDY clearly shows her sensitivity to the patterns in her input. This suggests that type frequency plays an important role in lexical and syntactic acquisition. Of the new VCs produced by MDY, 80% (25 out of

31) fall into the most frequent categories of VCs in the adult input – DVCs, RVCCs, and RVCs.

Now let us look at JIA's data from 2;6 to 2;10. The overall type/token ratio of VCs in her speech is 0.52 (76/135), compared to 0.46 (99/216) in her caregivers' speech. Thirty-eight percent of her VCs (27 out of 70) were not in her input in the sampled data. Among these VCs, she often combined a constant V_1 or V_2 with different verbs, for example, *chu1* 'exit' in ***chu1**-lai2* 'exit-come' (2 tokens, 2;7) and ***chu1**-qu4* 'exit-go' (1 token, 2;9), and *qu4* 'go' in *guo4-**qu4*** 'cross-go' (1 token, 2;8) and *xia4-**qu4*** 'descend-go' (2 tokens, 2;8). *Kai1* 'open' was also frequently combined with an action verb, as in *jie3-**kai1*** 'unravel-open' (1 token, 2;8) and *da3-**kai1*** 'hit-open' (8 tokens, 2;1 and 2;7). Three-verb compounds also occurred in JIA's speech, e.g., *diao4-xia4-qu4* 'fall-descend-go' (1 token, 2;7), *fang4-xia4-qu4* 'put-descend-go' (1 token, 2;8), and *na2-chu1-lai2* 'take-exit-come' (2 tokens, 2;7). And she also produced the potential forms of VCs, such as *na2-bu4-chu1-lai2* 'take-not-exit-come' (cannot take out) (2 tokens, 2;8). Like MDY, JIA used these new VCs only once or twice in the samples.

Comparing JIA and her caregivers, we also see a very similar distribution of frequency of VC subcategories, shown in Figure 4.4.

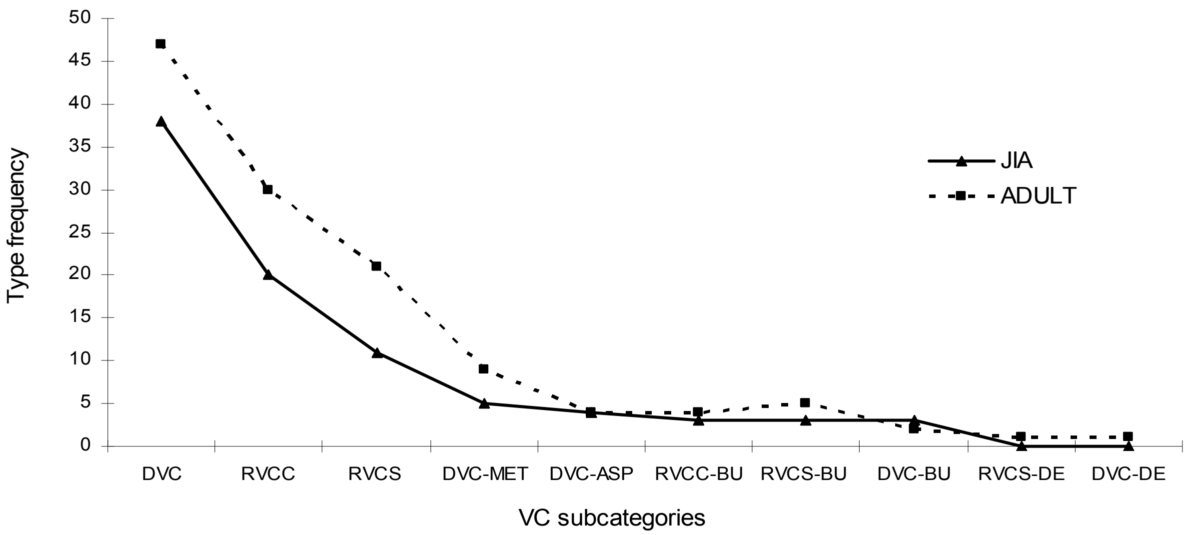


Figure 4.4. Type frequencies of VC subcategories in the speech of JIA and her caregivers

Just as for MDY and her caregivers, the most frequent categories of VCs in the speech of both JIA and her caregivers were DVCs, RVCCs, and RVCs. It is striking that across these two children and their caregivers, the frequency of different construction patterns matches so closely.

Overall, MDY and JIA are similar in their production of VCs. They show some knowledge of the combinatorial nature of verb compounds from around the age of 2;7, but this productivity seems to be limited to a few verbs (serving either as V_1 or V_2), and new VCs are not very frequent. The frequency of the subcategories of VCs in their speech clearly reflects the input patterns.

To summarize, the data from the Fang corpus and the Beijing corpus reveal that learners of Mandarin begin to produce VCs from a very early age, around 1;4 to 1;7. Before age 2 they do not seem to understand the compositional nature of verb compounds. But from 2;6 the use of VCs increases rapidly, and it still continues to rise beyond the age of 3. Productive uses of VCs show up at around 2;6, but they seem to revolve around a small number of verbs, and new VCs (i.e., VCs that are not found in the caregivers' sample) are quite rare in the data. The children and their caregivers showed a very similar distribution of the subcategories of DVCs and RVCs, with the children's early productive VCs instantiating the most frequent categories of VCs in the input. This overall learning pattern seems consistent with the usage-based account of learning, which posits a gradual inductive process based closely on the input. Note in particular that children's early productions of VCs mirrors the language input closely: their early VCs are among the highest-frequency VCs in the input, the frequency with which they produce different types of VCs matches that of the adult input, and their early productivity revolves to a large extent around pivot-like structures in which the verb in one slot is held constant while the verb in the other varies.

Naturalistic data give us a general developmental picture and allow us to explore the relationship between the input and the output, but, given the limited numbers of VCs in the data, it is not clear how productive children are at around 2;6 in creating novel verb compounds that follow conventional patterns of word formation in Mandarin. Can they apply and create VCs as needed, as adults do, to describe novel events of motion and state change? As discussed in Chapter 3, the frequent use of a construction does not necessarily indicate full productivity. Children's initial correct uses of a construction may have been picked up from the input and used as unanalyzed chunks; an implicit reorganization may take place only later, as learners become sensitive to the semantic and syntactic commonalities between the forms, and integrate them under a common rule system (Bowerman, 1982).

To determine whether children have developed an abstract schema which they can apply productively, it is helpful to carry out controlled elicitations in which they are asked to describe events that they have not encountered in their daily life. In the following section, I discuss three experimental studies that I conducted to investigate: (1) whether children can apply their knowledge of verb compounding to new situations (Experiments 1 and 2); and (2) whether and when children learn the semantic constraints on the formation of VCs (Experiment 3).

4.4 Elicited data

Experiment 1 probed children's knowledge of DVCs, and Experiment 2 their knowledge of RVCs. The participants in these experiments were recruited from two kindergartens in Guangzhou, P. R. China: Guangzhou Blue-sky Kindergarten and South China Agricultural University Kindergarten. Although Cantonese is widely spoken in Guangzhou, these kindergartens use Mandarin as their language of education,[36] and all the child participants had parents whose native language was Mandarin or a dialect of Mandarin. Judging from my analysis of the longitudinal spontaneous speech data, 2;6 is likely to be an age at which children begin to use VCs productively, so I chose 2;6-year-olds as my youngest subject group. The participants were four groups of children with mean ages of 2;6 (age range 2;5 – 2;9), 3;6 (3;5 – 3;8), 4;6 (4;3 – 4;7) and 6;1 (5;4 – 6;10), and a group of adults (mean age 31); there were 10 participants in each age group. Most parents of these children have received higher education, and work in schools, universities, companies, and government bureaus. The children are all only children (due to the "one-child" policy in China). They live in a metropolitan city and are immersed early in a culture featuring children's books, toys, cartoons, and television programs. They are used to watching cartoon animations, looking at books, describing pictures, and telling stories.

4.4.1 Experiment 1: DVCs in the Tomato Man study

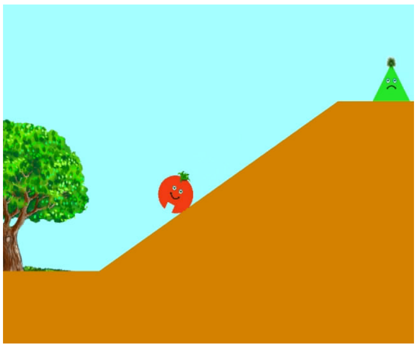
Let us first look at the *Tomato Man* study, which is named after the major character of the stimuli. This study was designed to probe children's use of DVCs through elicited descriptions of motion events that involve a change of location of a Figure. The specific questions addressed in the *Tomato Man* study are: How productive are children in using DVCs to describe motion events? Is there a difference across age?

[36] It is a national educational policy to promote the use of standardized Mandarin Chinese in all schools in China. All teachers are required to speak Mandarin at schools.

Stimuli

This task, a narrative task features a set of animated video stimuli, named *Tomato Man*, which was developed by Allen, Özyürek, and Kita (Allen, Özyürek, Kita, Brown, Furman, Ishizuka, & Fujii, 2007). It is composed of 12 short video clips that depict motion events carried out by two cartoon characters, *Tomato Man* and *Green Man*. Each clip lasts about 6 seconds, with the longest lasting 18 seconds. Each motion event consists of three phases: an initial phase, a target phase, and a closing phase. In the initial phase, a tomato-shaped protagonist (Tomato Man) and a green triangle-shaped protagonist (Green Man) typically enter the scene. In the target phase, one character performs a target action which simultaneously incorporates both Manner and Path. In some events, the non-target character also performs an action; this action depicts either Manner or Path, but not both. The characters normally leave the screen during the closing phase.

The "roll-down" clip, for example, begins with Tomato Man standing at the top of a hill. Green Man enters the scene and knocks Tomato Man down. Tomato Man then rolls down the hill and bumps into a tree at the bottom. In this clip, Tomato Man was the target character performing the target motion event "roll down". A sample still picture from the clip is shown in Figure 4.5. The event would typically be described in Mandarin with a DVC, e.g., *gun3-xia4* 'roll-descend'.



ROLL DOWN

Xi1hong2shi4	***gun3-xia4***	*le*	*shan1po1.*
Tomato	**roll-descend**	PFV	hill

'Tomato rolled down the hill.'

Figure 4.5. Sample still from Tomato Man

The complete list of motion events shown in the stimuli is given in Table 4.5, with the target events indicated by the names of the stimuli. For example, the Roll_up clip shows Tomato Man rolling up a cliff, and the Spin_down clip shows Green Man spinning down a hill.

Table 4.5. Stimulus motion events in Tomato Man elicitation

No.	Stimulus items
Practice 1	Glide_Up
Practice 2	Spin_Around
1	Roll_Up
2	Rotate_Down
3	Jump_Up
4	Spin_Down
5	Roll_Down
6	Jump_Around
7	Jump_Down
8	Rotate_Up
9	Spin_Up
10	Tumble_Down

Procedure

Children were tested and video-recorded individually in a playroom in their kindergarten, where they felt at ease and all the equipment was available. The adults were tested and audio-recorded in their own home or that of the experimenter. Each participant watched the twelve video clips one by one on a laptop. The adults were simply asked to describe what they saw in each clip. The children were tested in a more child-friendly manner. Each child was invited to play a "story-telling" game with two listeners (experimenters), whose native language was Mandarin. One sat opposite the child and was unable to see the laptop screen, and the other sat next to the child. The child was asked to tell what she had seen to the experimenter who could not see it. To engage the youngest children in the task, a toy puppy was also used, which – manipulated by the experimenter opposite to the child – acted as if it was eager to know what the child had seen.

After a warm-up period in which the task was explained, the child completed two practice trials (Practice 1 and 2 in Table 4.5). In the first practice trial she was introduced to the two characters and to the background scene, and asked to name the characters in any way she liked. Names applied to the Tomato Man included *hong2 ping2guo3* 'red apple', *yuan2xing2* 'round-shape' (circle), *yuan2yuan2* 'round-round' (circle), *hong2 cao3mei2* 'red strawberry', and *xi1hong2shi4* 'tomato'; names for the Green Man included *lü4san1jiao3* 'green triangle', *san1jiao3xing2* 'triangle', *bo1cai4* 'spinach', and *lu4 bai2cai4* 'green cabbage'. After the second trial run, the child was shown the ten target clips one by one. Each clip was shown twice, followed by a blank screen. Additional viewings were provided if the child could not remember what had happened. If the child did not provide any relevant description of the motion events, especially of the target phase, the listener would look puzzled and probe with questions like "What about the Tomato Man (Green Man)?" or "What happened next/before that?" or "And then?".

Results

To give an impression of how the participants described the events, I show a description of the "roll-down" clip from every age group:

(54) (2;6): *Hong2 ping2guo3 gun3-xia4-qu4, peng4-dao4 shu4 le.*
Red apple roll-descend-go bump-reach tree PFV
'Red apple rolled down and bumped into the tree.'

(55) (3;6): *Kan4jian4 ping2guo3 gu1lugu1lu gun3-xia4-lai2 le.*
See apple IDEOPH roll-descend-come PFV
'I saw that the red apple rolled down (rolling sound).'

(56) (4;6): *Wo3 kan4jian4 san1jiao3xing2 yi1 zhuang4 yuan2xing2*
I see triangle one bump circle
yuan2xing2 gun3 ya gun3 gun3-dao4 shan1po1 xia4mian4 le.
circle roll SPF roll roll-arrive hill.slope bottom PFV
'I saw the triangle bumped the circle once, and the circle rolled and rolled and rolled to the bottom of the hill.'

(57) (5;5): *San1jiao3xing2 ba3 ping2guo3 zhuang4-xia4-qu4*,
Triangle BA apple bump-descend-go
ta1 jiu4 gun3-xia4-qu4 le jiu4 zhan4-zhu4 le,
it then roll-descend-go PFV then stand-hold PFV
zhan4 zai4 shu4 pang2.
stand at tree side
'The triangle bumped the apple down. It rolled down, and then stopped beside the tree.'

(58) (24;7): *San1jiao3xing2 zhuang4 le yuan2xing2,*
Triangle knock PFV circle
yuan2xing2 gun3-xia4 le shan1po1.
circle roll-descend PFV hill
'The triangle knocked into the circle and the circle rolled down the hill.'

Figure 4.6 presents the type and token frequencies of DVCs produced by the participants in the different age groups.

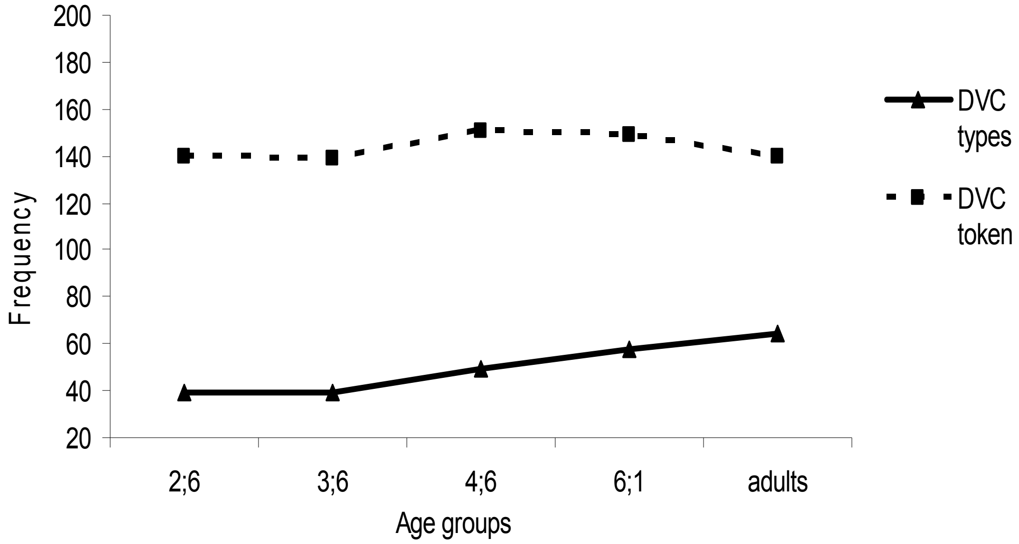


Figure 4.6. DVC types and tokens in the Tomato Man elicitation by age

From the youngest age group (2;6) on, children produced DVC tokens just as frequently as adults, and they used not only two-verb DVCs but also three-verb DVCs. They were able to capture both the manner (e.g., “spinning” vs. “jumping”) and the direction of the motion events by using DVCs formed with a manner of motion verb followed by a trajectory Path verb and often a deictic Path verb as well, e.g., *gun3-shang4-lai2* ‘roll-ascend-come’, *zhuan4-shang4-lai2* ‘spin-ascend-come’, *gun3-xia4-qu4* ‘roll-descend-go’, *tiao4-shang4-qu4* ‘jump-ascend-go’, and *tiao4-xia4-qu4* ‘jump-descend-go’. Among their two-verb DVCs, the most frequent were combinations of a trajectory Path verb with a deictic Path verb, e.g., *shang4-lai2* ‘ascend-come’; this is consistent with the spontaneous speech data discussed in §4.3. In two-verb compounds, manner of motion verbs were typically combined with a trajectory Path verb, as in *tiao4-xia4* ‘jump-descend’ and *gun3-xia4* ‘roll-descend’.

The children also produced a diversity of DVC types. Altogether the 40 children produced 109 DVC types, while the 10 adults produced 62. Only 20 DVCs are shared by the children and the adults. To give an idea of the productivity of DVCs, I show in Table 4.6 some examples produced by both the children and the adults, as well as those used only by the children and only by the adults. These DVCs are grouped by their complement Path verbs (trajectory or deictic), which form a closed set in Mandarin. To avoid repetition of the complement verbs, I list in columns 2 through 4 only the verbs that occur as V_1 with that complement.

Table 4.6. Exemplar DVCs produced by the children and the adults to the Tomato Man elicitation (Note: Novel [i.e., odd-sounding] compounds are bolded and marked with an asterisk *.)

DVCs	V_1 shared	V_1 by children only	V_1 by adults only
V_1-shang4-lai2 'V_1-ascend-come'	*beng4* 'jump'	*gun3* 'roll' *zhuan4* 'spin' *jiu4* 'rescue' *zou3* 'walk' *tiao4* 'jump' *pao3* 'run'	
V_1-xia4-lai2 'V_1-descend-come'	*diao4* 'fall' *tiao4* 'jump' *hua2* 'slide' *beng4* 'hop'	*gun3* 'roll' *die1* 'fall' *zhuan4* 'spin' *zhuang4* 'bump' *gao3* 'make' *fan1* 'do.somersault' *zai1* 'tumble'	*luo4* 'fall'
V_1-chu1-lai2 'V_1-exit-come'		*peng4* 'bump'	*hua2* 'slide' *chong1* 'rush' *fei1* 'fly' *yi2* 'move' *beng4* 'jump'
V_1-shang4-qu4 'V_1-ascend-go'	*gun3* 'roll' *beng4* 'jump' *hua2* 'slide'	*zou3* 'walk' *fei1* 'fly' *zhuan4* 'spin' *pao3* 'run' *tiao4* 'jump' *zhuan4* 'spin' *tui1* 'push' *yi2* 'move' ****dong4*** 'dong' (IDEOPH)	*fu2* 'float'
V_1xia4-qu4 'V_1-descend-go'	*gun3* 'roll' *diao4* 'fall' *hua2* 'slide'	*zhuan4* 'spin' *tiao4* 'jump' *zhuang4* 'strike' *tui1* 'push' *fei1* 'fly' *peng4* 'knock' *chen2* 'sink' *zou3* 'walk' ****gun3-diao4*** 'roll-fall' ****zou3-diao4*** 'walk-fall'	
V_1-xia4-lai2 'V_1-descend-come' (V_1 off)	*gun3* 'roll' *diao4* 'fall' *hua2* 'slide' *tiao4* 'jump' *beng4* 'hop'	*zhuan4* 'spin' *fan1* 'do.somersault' *gao3* 'make' *dei1* 'fall'	*luo4* 'fall'
V_1-shang4 'V_1-ascend'	*pa2* 'climb' *gun3* 'roll'	*fei1* 'fly' *tui1* 'push' *pao3* 'roll' *tiao4* 'jump'	*hua2* 'slide' *zou3* 'walk'
V_1-qi3-lai2 *'V_1-rise-come'*	*fei1* 'fly'	*gun3* 'roll' *tiao4* 'jump' *duo3* 'hide'	

As this table shows, the children produced a variety of DVCs, including *Manner of motion verb + Path verb + Deictic verb* combinations as well as *Path verb + Deictic verb* combinations. Among these DVCs, some were also produced by ("shared by") the adults, but many were not. The majority of the DVCs produced by children are conventional ones that adults might also use, but some are odd. For example, a child of 3;5 used an onomatopoetic word, *dong4*, which captures the thumping sound of jumping, as the first verb of a compound; adults would not use an onomatopoetic word as a verb:

(59) (3;5): *Ta1* ***dong4-shang4-qu4*** *le.*
He **dong-ascend-go** PFV
'He ascended the hill, donging / he donged up the hill.'

Another type of error is the creation of DVCs with more than three verbs, as in the following:

(60) (4;5): *Ta1* ***gun3-diao4-xia4-qu4*** *le.*
He **roll-fall-descend-go** PFV
'He fell down while rolling.'

(61) (4;5): *Ta1* ***zou3-diao4-xia4-qu4*** *le.*
He **walk-fall-descend-go** PFV
'He fell down while walking.'

The children's novel DVCs, although interpretable in context, sound strange to adult ears, especially those with more than three verbs. They show that the child must have analyzed conventional verb compounds into their component parts, and understands what kind of verb goes in which slot. In the case of *dong4-shang4-qu4* 'dong-ascend-go', for example, the ordering of the words is correct even though *dong4* is odd, since this word is used to indicate the manner of the motion, and manner of motion verbs indeed go in the V_1 slot. It is worth noting that there are no ordering errors in the data.[37]

To summarize, the children used DVCs productively in this experiment to encode motion events from at least 2;6, which is fully in line with the more tentative results obtained from my analyses of spontaneous speech corpora reported in §4.3. The variety of DVCs in the children's descriptions, and their production of novel VCs, suggest that they were not just reproducing a small set of highly frequent DVCs that they might hear every day. In an experimental situation with novel events, participants cannot just repeat what they have heard

[37] Mandarin children have been observed to make ordering errors in nominal compounds, for example, *shua1-ya2* 'brush-tooth' for *ya2-shua1* 'tooth-brush' (H.-T. Cheung, p.c.).

said in familiar situations; they have to be able to analyze the new events into their relevant components, even if the VCs they use may have been heard before for other “similar” events. The frequency with which children even as young as 2;6 used DVCs also suggests that they have already learned the characteristic linguistic encoding of motion events in Mandarin, which captures both Manner and Path information in a single construction. They also used three-verb DVCs, e.g., *gun3-shang4-lai2* ‘roll-ascend-come’ and *zhuan4-shang4-lai2* ‘spin-ascend-come’. Productivity is further attested by children’s creation of novel DVCs to encode the events depicted. The length of some of these compounds suggests that learners are not yet sensitive to constraints on the number of verbs that can be combined.

4.4.2 Experiment 2: RVCs in the Kids’ Cut and Break study

The questions addressed in Experiment 2 are parallel to those addressed in Experiment 1, but they are about state change rather than motion events: How do children describe caused state-change events? How productive are children in using RVCs when describing these events? Is there a difference across age? To explore these questions, I examined a specific semantic domain, that of “cutting and breaking” events (henceforth C&B events), which encompasses events that involve separation or destruction in the material integrity of objects (Hale & Keyser, 1987). These are complex events composed of two subevents, a causing subevent and a result subevent.

The C&B domain was chosen for the following reasons. Every human society must cut and break things in one way or another. Children learning different languages are exposed to such events from an early age, and they hear people talking about them. But languages vary in how they encode and categorize them (cf. Erkelens, 2003; Majid, Bowerman, van Staden, & Boster, 2007; Majid, van Staden, Boster, & Bowerman, 2004; Pye, 1994). Verbs of cutting and breaking have also figured prominently in the linguistic literature on lexical representation. In particular, *cut* and *break* are both “verbs of externally-caused state change” (Levin & Rappaport Hovav, 1995), but they show systematic syntactic differences in their argument structure alternation possibilities. Much research has gone into showing how these differences can be projected from the meanings of the two words, and their counterparts in other languages (Guerssel, Hale, Laughren, Levin, & White Eagle, 1985; Levin & Rappaport Hovav, 1995).

Mandarin is a language that shows rather special typological features in encoding C&B events: it consistently uses RVCs. As a whole, RVCs entail the state change specified by the second verb, and there is a clean division of labor between the component verbs. This is illustrated in (62).

(62)	*Ta1*	***qie1-duan4***	*le*	*shen2zi.*
	He	**cut.with.single.blade-be.broken**	PFV	rope

‘He cut the rope.’

In this example, the first verb (V_1) of the compound, *qie1*, encodes only the subevent of a cutting action and the second verb (V_2), *duan4*, encodes the result state of a long object being broken across. An alternative way to encode a C&B event is to use a simplex action verb in one clause and a result verb in another, perhaps combining the two clauses into a coordinate construction, as in (63):

(63)	*Ta1*	***qie1***	*shen4zi;*	*shen4zi*	***duan4***	*le.*
	He	**cut.with.single.blade**	rope	rope	**be.broken**	PFV

‘He cut the rope and it broke.’

The use of only one type of verb, an action verb such as *qie1* or a result verb such as *duan4*, for example, captures only one aspect of the complex event. As mentioned in Chapter 2, Mandarin has few monomorphemic verbs that, like English *cut* and *break*, lexicalize both a causal action and a caused state change. Instead, it employs the productive process of combining two simplex verbs in an RVC.

Stimuli

To collect descriptions of C&B events, I used a stimulus set of video clips, “Kids’ Cut & Break”, designed and created by Bowerman, Majid, and Erkelens (2003; Bowerman, Majid, Erkelens, Narasimhan, & Chen, 2004; Erkelens, 2003) at the Max Planck Institute for Psycholinguistics. Table 4.7 shows the complete list of stimulus events.

Table 4.7. Stimulus cutting and breaking events in Kids' Cut & Break

No.	Target C&B events
1	Cutting a piece of paper with scissors
2	Breaking a twig by hand
3	Cutting a slice of bread with a knife
4	Tearing a piece of paper along a knife
5	Tearing a piece of cloth by hand
6	Cutting nails with a nail clipper
7	Breaking a bar of chocolate by hand
8	Cutting a piece of cake with a piece of a broken pot
9	Cutting an egg in slices with a wire egg cutter
10	Breaking a pot with a hammer
11	Cutting a twig off a tree with a knife
12	Cutting the head of a nail off with a pair of pliers
13	Cutting cardboard with a knife
14	Tearing a slice of bread in two pieces by hand
15	Cutting hair with scissors
16	Tearing open a plastic bag by hand
17	Cutting a banana in pieces with a knife
18	Breaking a baguette by hand
19	Tearing a banana peel in two with a pair of pliers
20	Tearing a piece of paper off a notepad by hand
21	Cutting cloth with scissors
22	Cutting bread with a single blade of scissors
23	Cutting a bunch of spring onions by moving them against a static knife
24	Cutting a twig off a tree with an axe
25	Breaking a glass by knocking it off the table with an elbow
26	Breaking a rope with chisel and hammer
27	Cutting a piece off a banana with scissors
28	Cutting a rope in two pieces with a knife
	Warm-up and filler events
	Eating a cookie
	Kicking a ball
	Drawing a face
	Opening a jar
	Throwing a ball
	Drinking a glass of juice

The stimulus set is composed of 34 video clips, including 28 target video clips, 2 warm-up clips, and 4 filler clips. Each target clip shows an event in which an actor brings about a state change in an object – specifically, some kind of destruction of the object's material integrity. For example, a woman breaks a bar of chocolate by hand, or cuts a piece of cloth into two pieces with scissors. Some sample still frames from the video stimuli are shown in Figure 4.7. Such events are typically encoded with RVCs in Mandarin, for example, *bai1* 'bend-be.broken', *jian3-po4* 'cut.with.double-blade-be.broken'.

Figure 4.7. Sample stills from "Kids' cut & break"

The stimuli were designed to be child-friendly: they featured brightly colored clothing and tablecloths, and the actors smiled and showed animated facial expressions. The stimulus set contained not only conventional actions such as cutting a piece of paper with scissors, but also novel actions such as cutting a banana in two with scissors and tearing a piece of bread against a knife blade. Novel events were included to test how productive children are in encoding C&B events.

Procedure

The participants in this elicitation experiment were the same groups of children and adults who took part in the Tomato Man study, and the procedure was also similar (see §4.4.1). Each participant watched the clips one by one on a laptop with the experimenters, and was asked to tell what he or she had seen.

Results

After the data were recorded, the descriptions of the C&B events were transcribed and coded. To give an impression of how the participants described the events, a description from each age group of the stimulus event "tearing cloth" is shown below (RVCs are indicated in bold).

(64) (2;6): *Zai4 si1 bu4.*
PROG tear cloth
'(Auntie) is tearing a cloth.'

(65) (3;5): *Ba3 yi1fu2* ***si1-lan4*** *le.*
BA clothing tear-be.torn PFV
'(Auntie) tore the clothing.'

(66) (4;6): *Yi1 ge a1yi2 yong4 shou3 ba3 bu4* ***si1-lan4*** *le.*
One CLF auntie use hand BA cloth tear-be.torn PFV
'An auntie tore the cloth by hand.'

(67) (6;0): *Yi1 ge a1yi2 ba3 yi1 kuai4 hua1bu4* ***si1-kai1*** *le.*
One CLF auntie BA one CLF colorful.cloth tear-be.apart PFV
'An auntie tore a colorful cloth apart.'

(68) (adult): *Yi1 wei4 nü3shi4 ba3 yi1 jian4 hua1 yi1fu2* ***si1-kai1*** *le.*
One CLF lady BA one CLF colorful clothing tear-be.apart PFV
'A lady tore a piece of colorful clothing.'

As these examples show, the participants typically encoded both the C&B action and the result in a single RVC, although members of the youngest group also sometimes produced a simplex action verb (as in (64)).

The type and token frequencies of RVCs from each age group are presented in Figure 4.8. The adults produced more RVC tokens overall than the children, but not more types. Even the youngest group of children produced a fair number of both types and tokens.

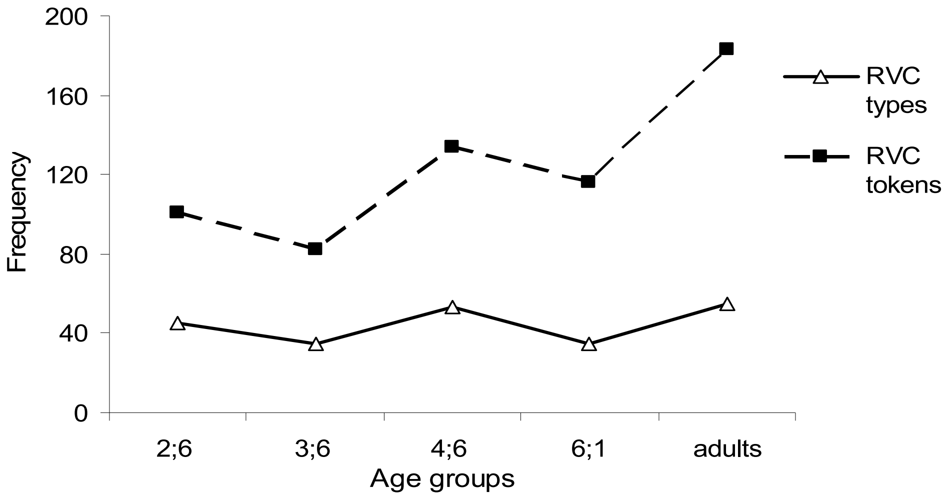


Figure 4.8. RVC types and tokens by age group in the C&B elicitation

To determine how productive the children were in verb compounding, I compared the RVC types produced by the children and the adults. The total of 40 children in the four groups produced 95 types altogether, whereas the 10 adults produced 55 types. The RVC types produced by the children are not simply a subset of those of the adults. Table 4.8 summarizes the RVCs produced by both children and adults, only children, and only adults. (These are classified by V_2 types in column 1, because there are fewer V_2s [verbs denoting results] than V_1s [verbs denoting actions].)

Table 4.8 Examples of the major types of RVCs produced by the children and the adults in response to the cutting and breaking stimuli[38]

RVCs	V_1 shared	V_1 by children only	V_1 by adults only
***V_1-kai1* ‘V_1-be.open/apart’**	*bai1* ‘bend’ *jian3* ‘cut.scissors’ *pie3* ‘bend’ *qie1* ‘cut.knife’ *che3* ‘stretch’ *si1* ‘tear’ *ge1* ‘cut’	*gao3* ‘make’ *da31* ‘pare’ *xiao1* ‘hit’ *fen11* ‘divide’ *chui2* ‘hammer’‘ *nong4* ‘make’ *cha1* ‘poke’	*cai2* ‘cut.knife’ *zao2* ‘chisel’ *qian2* ‘clamp’
***V_1-duan4* ‘V_2-be.broken’**	*bai1* ‘bend’ *hua4* ‘divide’ *jian3* ‘cut.scissors’ *qie1* ‘cut.knife’ *pie3* ‘bend’ *che3* ‘stretch’ *cai2* ‘cut.knife’	*nong4* ‘make’ *kan3* ‘hack’ *gao3* ‘make’ *shuai1* ‘drop, fall’ *si1* ‘tear’ *la1* ‘pull’ *da3* ‘hit’ *ba2* ‘pull’	*zhe2* ‘bend’ *mo2* ‘grind’ *ge1* ‘cut’ *zao2* ‘chisel’ *ju4* ‘saw’ *chui2* ‘hammer’ *jia2* ‘squeeze’ *lei1* ‘clamp’ *ding1* ‘nail’ *qian2* ‘squeeze’ *jie2* ‘sever’
***V_1-sui4* ‘V_2-be.in.pieces’**	*da3* ‘hit’	*qie1* ‘cut’ *bai1* ‘bend’ *si1* ‘tear’ *gao3* ‘make’ *ding1* ‘nail’ *za2* ‘hammer’	*chui2* ‘hammer’ *shuai1* ‘drop, fall’
***V_1-lan4* ‘V_2-be.smashed’**	*si1* ‘tear’ *chui2* ‘hammer’ *da3* ‘hit’	*gao3* ‘make’ *shuai1* ‘drop, fall’ *mie1* ’make’ *bai1* ‘bend’ *nong4* ‘make’ *qie1* ‘cut’ *hua4* ‘divide’ *qiao1* ‘knock’ *jian3* ‘cut.scissors’ *kan3* ‘hack’ *ju4* ‘saw’ *ba2* ‘pull’	*za2* ‘pound’
***V_1-diao4* ‘V_2-fall’ (V_2-off)**		*gao3* ‘make’ *kan3* ‘hack’ *si1* ‘tear’ *jian3* ‘cut.scissors’ *qie1* ‘cut’ *che3* ‘pull’ *bai1* ‘bend’ *bo1* ‘peel’ *nong4* ‘make’	*qian2* ‘clamp’
***V_1-xia4-lai2* ‘V_1-descend-come’ (V_1-off)**	*si1* ‘tear’ *jian3* ‘cut.scissors’ *qie1* ‘cut.knife’	*bai1* ‘bend’ *mie1* ‘make’ *chui2* ‘hammer’ *gao3* ‘make’ **sha1* ‘kill’ *nong4* ‘make’	*xiao1* ‘pare’ *kan3* ‘hack’ *ge1* ‘cut.knife’ *ju4* ‘saw’ *za2* ‘pound’ *jie2* ‘sever’
***V_1-huai4* ‘V_2-be.broken’**		*nong4* ‘make’ *bai1* ‘bend’ *qie1* ‘cut’ *da3* ‘hit’ *jian3* ‘cut.scissors’ *qiao1* ‘knock’ *si1* ‘tear’ *che3* ‘stretch’	*jian3* ‘cut.scissors’ *chui2* ‘hammer’

[38] The English glosses do not capture the meanings of the Mandarin verbs exactly. The semantics of Mandarin C&B verbs are discussed in Chapter 6.

As shown in Table 4.8, the children combined many different V_1s and V_2s. As an example, their RVCs with *kai1* 'be.open/apart' as V_2 are summarized in Table 4.9, broken down by age. We can see that even the youngest 2;6-year-olds were able to produce RVCs with a variety of V_1s and to use these compounds frequently.

Table 4.9. RVCs with different V_1s combined with V_2 *kai1* 'be.open' (*V_1-kai1*), by age

(Note: Numbers in parentheses represent token frequencies.)

2;6-year-olds (20)		**3;6-year-olds (31)**		**4;6-year-olds (63)**		**6;1-year-olds (30)**	
V_1-*kai1*		**V_1-*kai1***		**V_1-*kai1***		**V_1-*kai1***	
bai1	'bend'	*bai1*	'bend'	*bai1*	'bend'	*bai1*	'bend'
jian3	'cut.scissors'	*jian3*	'cut.scissors'	*jian3*	'cut.scissors'	*jian3*	'cut.scissors'
qie1	'cut.knife'	*qie1*	'cut.knife'	*qie1*	'cut.knife'	*qie1*	'cut.knife'
si1	'tear'	*si1*	'tear'	*si1*	'tear'	*si1*	'tear'
da3	'hit'	*da3*	'hit'	*gao3*	'make'	*gao3*	'make'
fen1	'divide/ split'	*gao3*	'make'	*ge1*	'cut'	*ba2*	'pull'
		nong4	'make'	*che3*	'stretch/pull'	*chuo1*	'poke'
		xiao1	'pare'	*pie3*	'bend'		
				chui2	'hammer'		
				cha1	'insert'		

Already by 2;6 the children seem to be productive in creating RVCs to describe the C&B events. This productivity is further confirmed by a case study of a 2;6-year-old's use of VCs and their component verbs in this elicitation. This child used the action verbs (V_1s) and the result verbs (V_2s) separately as well as combined in RVCs, as shown in Table 4.10. The same action verbs were combined with different result verbs, e.g., *gao3-lan4* 'make-be.smashed' and *gao3-duan4* 'make-be.broken'; and the same result verbs were combined with different actions verbs, for example, *bai1-lan4* 'bend-be.smashed' and *gao3-lan4* 'make-be.smashed'.

Table 4.10. Cutting and breaking events – one 2;6-year-old's predicates

(Note: Numbers in parentheses indicate token frequencies beyond one.)

V_1 (alone)		**V_2 (alone)**		**V_1-V_2**	
jian3 (3)	'cut.scissors'	*huai4* (6)	'be.broken'	*jian3-huai4*	'cut.scissors-be.broken'
bai1	'bend'	*kai1*	'open'	*bai1*	'bend'
		lan4	'be.smashed'	*bai1-lan4*	'bend-be.smashed'
				gao3-lan4	'make-be.smashed'
		duan4	'be.broken' (of linear objects)'	*gao3-duan4* (2)	'make-be.broken'

The majority of the RVCs produced by the children were conventional, but two novel combinations were observed:

(69) 3;6: **Che3-bai1* 'pull-bend'

(Describing an event of cutting spring onions by moving them against a static knife.)

(70) 4;6: **Sha1-xia4-lai2* 'kill-descend-come' (kill off)[39]

(Describing an event of cutting a twig with a knife.)

These combinations sound odd to adult ears, and are hard to interpret out of context. They are unlikely to have been modeled in the adult speech to the children.

Summary

To summarize the findings from both the spontaneous and elicited speech, Mandarin-speaking children use DVCs and RVCs from an early age. Their early uses are restricted to VCs that they have heard in the input. But by at least age 2;6, they become very productive with VCs: they are able to analyze VCs into two or more parts, and link each part with a function. For DVCs they have determined which verb expresses the Manner of motion and which the Path, and for RVCs they know which verb expresses the cause and which the result.

Evidence for productivity comes from the data elicited in the Tomato Man study and the Kid's Cut & Break study: (1) The children produced a variety of conventional verb compounds which overlap only partially with those produced by the adults in the same contexts; (2) they created non-canonical verb compounds with novel V_1s; (3) they combined more verbs than the grammar of Mandarin allows; (4) they used given action and result verbs alone as well as in combination; and (5) they never erred in the ordering of the component verbs. This evidence for productivity suggests that children become sensitive to the Mandarin style of encoding events at an early age. In learning Mandarin verb compounding, children may start out with an item-based learning procedure, but they quickly make abstractions, analyzing verb compounds into their components and structuring them according to an overarching constructional template.

4.4.3 Experiment 3: Knowledge of semantic constraints on verb compounding in the VC Constraints study

In a language like Mandarin, it is possible to coin a novel compound on the spot. If it fits an acceptable pattern (e.g., *antifulfillment* RVCs such as *ca1-zang1* 'wipe-be.dirty' or *other-event* RVCs such as *xi3-po4* 'wash-be.torn', see §2.7), it may pass unnoticed. But if it violates semantic constraints, it will strike other speakers as odd or unacceptable. What do

39 *Xia4-lai2* 'descend-come' can be conventionally glossed as 'off'.

children know about these constraints? Experiment 3 explores this question. This experiment involved both a description task and a judgment task. These two tasks allowed me to determine how Mandarin learners describe events of caused state change or location change that cannot be encoded with a DVC or an RVC (see §2.8), such as pulling on someone and causing him to stand up (**la1-zhan4* 'pull-stand'), and whether they accept such RVCs as descriptions of such events.

The participants were recruited from two kindergartens and a primary school in Guangzhou, Guangzhou Blue-sky Kindergarten, South China Agricultural University Kindergarten, and the Primary School attached to South China Normal University in Guangzhou, P. R. China. The participants were five groups of children, with mean ages of 2;6 (age range 2;5 – 2;9), 3;6 (3;5 – 3;8), 4;6 (4;3 – 4;7), 6;1 (5;4 – 6;10), 8;1 (7;8 – 8;8), and a group of adults (mean age 31); there were 10 participants in each age group.[40]

Stimuli

The stimulus set consisted of 42 video clips: 34 target clips, 2 warm-up items, and 6 control items (the control items will be explained shortly). Each target clip depicted an actor performing a causal action that resulted in a location change or a state change, for example, a woman blowing out a burning candle. Eighteen of the events could be routinely described with a verb compound and sixteen could not. The compounds that the description task pulled for were also used in the judgment task (details are explained under *Procedure*, below). Table 4.11 lists the conventional and strange VCs studied in this experiment, classified according to the semantics of the V_2. These V_2s, which include posture verbs, manner of motion verbs, verbs of ceasing, and verbs of closing, are not accepted in the V_2 slot by native speakers of Mandarin (see §2.8). Both the conventional VCs and the strange VCs used in this experiment were chosen on the basis of my own intuitions and those of two other native speakers of Mandarin.

[40] The 2;6-, 3;6-, 4;6-, and 6;1-year-olds also participated experiments 1 and 2.

Table 4.11. Verb compounds tested in the *VC Constraints* study
(Note: Asterisks indicate unacceptable VCs.)

Semantic classes of V_2s	VCs tested	
Path	*chui1-diao4*	'blow-fall'
	reng1-chu1	'throw-exit'
	ju3-qi3	'lift-rise'
	fang4-xia4	'put-descend'
Manner of motion	**tui1-hua2*	'push-slide'
	**reng1-fei1*	'throw-fly'
	**la1-zhuan4*	'pull-spin'
	**tui1-huang4*	'push-shake'
	**ti1-gun3*	'kick-roll'
	**chui1-gun3*	'blow-roll'
	**la1-tan2*	'pull-jump'
Breaking	*ji3-po4*	'squeeze-break'
	reng4-sui4	'throw-smash'
	chui1-po4	'blow-break'
	zhe-duan42	'bend-break'
Opening	*ti1-kai1*	'kick-be.open'
	tui1-kai1	'push-be.open'
Closing	**ti1-guan1*	'kick-close'
	**tui1-guan1*	'push-close'
	**la1-guan1*	'pull-close'
Ceasing	*gai4-mie4*	'cover-extinguish'
	**zhuang4-ting2*	'bump-stop'
	chui1-mie4	'blow-extinguish'
	**an4-ting2*	'press-stop'
Posture	**la1-zhan4*	'pull-stand'
	**tui1-zuo4*	'push-sit'
	**tui1-tang3*	'push-lie'
	**an4-dun1*	'press-squat'
Other	*ti1-fan1*	'kick-overturn'
	ti1-dao3	'kick-fall'
	tui1-dao3	'push-fall'
	xi3-zang1	'wash-dirty'
	pai1-shi1	'pat-wet'
	tu2-hong2	'paint-red'

The procedure

The participants were seen individually in a quiet room in their school. They were shown the video clips one by one. For each clip, they were (a) first asked to describe what had happened; and then – if they had not used the target verb compound in their description – they were (b) asked to judge whether the target verb compound was acceptable. For conventional VCs such as *chui1-mie4* 'blow-extinguish', participants were expected to give a "yes" answer in the judgment task, whereas for odd ones such as *la1-zhan4* 'pull-stand', they were expected to give a "no" answer. A child-friendly version of this procedure was used with the children. First a toy puppy was introduced to the child, which was described as silly but eager to learn the child's language. The child was asked to describe the video clip for the puppy. If she did not produce the target verb compound, the puppy would describe the event with a sentence that included the target verb compound, and the child was then asked to judge whether this sentence matched what she had seen in the video clip. To forestall a "yes" bias on the judgment task, I included 6 relatively easy control events in the stimulus set, half requiring "no" answers and half "yes" answers. For example, for a video clip depicting a man mopping the floor, the child was expected to say "no" to the puppy who said the man was sweeping the floor. Only children who gave correct responses to all the control items were included in the analysis.[41] The children were all video-taped and the adults were audio-taped.

Results

The video and audio recordings were digitized, and the relevant descriptions of each video clip were transcribed. The judgments given for each clip were also noted down for all the participants. The children and the adults used both conventional verb compounds and single verbs in their descriptions. But the children also produced odd VCs that never occurred in adults' descriptions, using verbs of posture, manner of motion, ceasing, and closing in the V_2 slot. This overproductivity was observed across the four youngest age groups of children, but not in the oldest child group nor among the adults. The token frequencies of these anomalous VCs are summarized in Table 4.12, and sample errors are shown in Table 4.13.

The oldest children (8-year-olds) and the adults never constructed novel VCs like these. Rather, for the events that cannot be described with a conventional RVC, they tended to use two or more separate clauses (as in 71), or some other syntactic constructions such as a periphrastic causative construction (as in 72).

(71) *Na4 wei4 nan2shi4 yong4 li4* ***chui1*** *qiu1, qiu2 jiu4 wang3 qian2* ***gun3****,*
That CLF man use strength blow ball ball then toward front roll
ran2hou4 diao4-dao4 di4 shang4 le.
then fall-arrive ground top PFV
'That man blew at the ball with strength; the ball then rolled forward and fell on the ground.' (*blow-roll)

(72) *Ta1 la1 na4 ge zhuan4pan2, shi3 ta1 zhuan4-qi3-lai2.*
He pull that CLF spin-table cause it spin-rise-come
'He pulled that spinning-table and caused it to begin to spin.' (*pull-spin)

[41] Two children (2;5 and 2;7) were excluded; they were replaced by two 2;6-year-olds who gave correct judgments.

Table 4.12. Experiment 3: Token frequencies of innovative VCs by V_2 and age

Age / V_2	2;6	3;6	4;6	6;1	8;1
Posture	1	4	4	2	0
Manner	2	2	3	2	0
Ceasing	3	2	3	2	0
Closing	2	4	3	3	0

Table 4.13. Experiment 3: Examples of innovative VCs by V_2 and age

Posture verbs	(1) (3;6)	*Na4 ge a1yi2* ***tui4-zuo4*** *le shu1shu.* That CLF auntie **push-sit** PFV uncle 'That auntie caused uncle to sit by pushing him.'
	(2) (3;6)	*A1yi2* ***la1-zhan4*** *le shu1shu.* Auntie **pull-stand** PFV uncle 'Auntie made uncle stand up by pulling on him.'
	(3) (6;2)	*A1yi2* ***an4-dun1*** *le shu1shu.* Auntie **press-squat** PFV uncle 'Auntie made uncle squat by pressing on him.'
Manner of motion verbs	(4) (3;6)	*Shu1shu* ***chui1-gun3*** *le lu4 qiu2.* Uncle **blow-roll** PFV green ball 'Uncle made the green ball roll by blowing at it.'
	(5) (4;6)	*Shu1shu* ***la1-zhuan4*** *le zhuo1zi.* Uncle **pull-spin** PFV table 'Uncle made the table spin by pulling on it.'
	(6) (4;6)	*Shu1shu* ***tui1-hua2*** *le a1yi2.* Uncle push-slide PFV auntie 'Uncle made auntie slide by pushing her (down the slide).'
	(7) (6;2)	*Shu1shu* ***tui1-huang4*** *le ayi.* Uncle push-shake PFV auntie 'Uncle made auntie shake by pushing her (as she sat on a swing).'
Verbs of closing	(8) (2;6)	*A1yi2* ***la1-guan1*** *le chuang1hu2.* Auntie **pull-close** PFV window 'Auntie closed the window by pulling on it.'
	(9) (3;6)	*Shu1shu* ***tui1-guan1*** *le men2.* Uncle **push-close** PFV door 'Uncle closed the window by pushing on it.'
	(10) (6;2)	*Shu1shu* ***ti1-guan1*** *le men2.* Uncle **kick-close** PFV door 'Uncle closed the door by kicking it.'
Verbs of ceasing	(11) (2;6)	*A1yi2* ***peng4-ting2*** *le che1.* Auntie touch-stop PFV car 'Auntie stopped the (toy) car by touching it.'
	(12) (2;6)	*A1yi2* ***tui1-ting2*** *le qi4che1.* Auntie push-stop PFV car 'Auntie stopped the (toy) car by pushing on it.'
	(13) (3;6)	*A1yi2* ***an4-ting2*** *le qi4che1.* Auntie **press-stop** PFV car 'Auntie stopped the (toy) car by pressing on it.'
	(14) (4;6)	*A1yi2* ***fang4-ting2*** *le qi4che1.* Auntie **put-stop** PFV car 'Auntie stopped the car by putting (a finger on) it.'

Now let us look at the judgment data. Figure 4.9 shows the percentage of acceptance of the target conventional VCs and the odd VCs by all age groups. Adults and children of all ages showed a very high acceptance rate of the conventional VCs (nearly 100%). But adults overwhelmingly rejected the odd VCs. Children up to the age of 6;1, in contrast, tended to accept most of the odd VCs, and even when they were as old as 8;1 they still accepted more than half of them. (Recall that all the children correctly rejected incorrect descriptions of the control items.) Children are, then, much more lenient with verb compounding than adults. They seem not to even begin to acquire a feel for disallowed combinations until beyond the age of six, and their knowledge of the semantic constraints on verb compounding is not complete until sometime after eight.

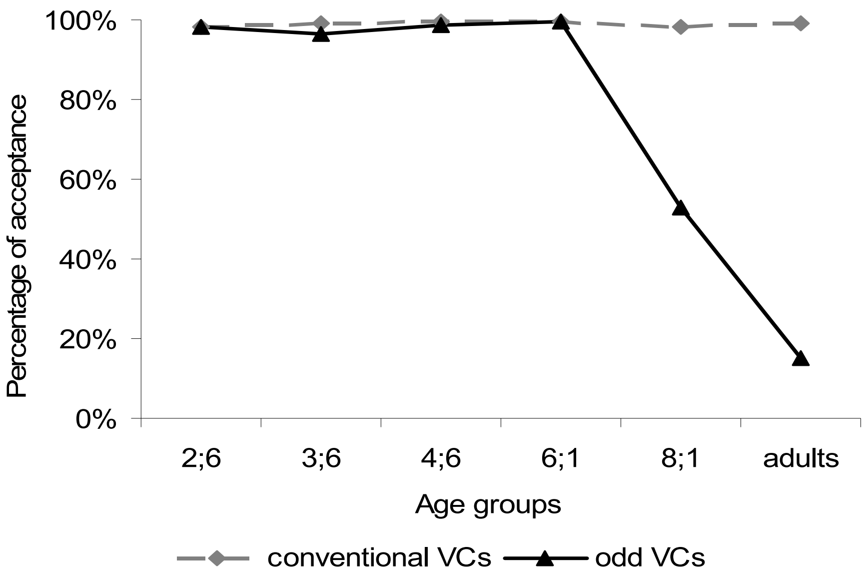


Figure 4.9. Percentage of acceptance of conventional VCs and odd VCs

To summarize the findings from Experiment 3, children from age 2;6 to 6;1 overgeneralize, creating verb compounds that sound strange to adults and that are unlikely to have been heard in the input. These results confirm my findings, based on spontaneous speech as well as two elicitation studies, that children know about the combinatorial nature of verb compounds by at least 2;6 (see §4.3). But the results go even further, showing that children are overproductive and do not know much about the semantic constraints on Mandarin verb compounding until remarkably late, well beyond the age of six. Working out these constraints is apparently a task of middle childhood or beyond.

4.5 Discussion and conclusions

This chapter has reported analyses of spontaneous speech data from two longitudinal corpora, as well as the results of three experimental studies. The aims of these studies were to determine: (1) the general course of development of DVCs and RVCs in learning Mandarin;

(2) when and how children become productive in verb compounding; (3) what they know about the constraints on verb compounding; and (4) how to account for the observed learning patterns.

My analyses of children's spontaneous speech data show that children start to use VCs at a very young age (around 1;4 to 1;7), but that their early uses (below about 2;2) are few, and do not show much productivity. Both the spontaneous speech data and the data elicited in Experiments 1 and 2 show that as children get older, they gradually use more VC types and tokens, and that they grasp the combinatorial nature of VCs by at least 2;6. From this point on they produce multiple verb compound types, they use the constituent verbs separately and combine them flexibly, and they never make errors in ordering the verbs. Children's reliance on VCs in the elicited data shows that they home in early on what for adults is the preferred strategy for encoding events of motion and state change in Mandarin: two- or three-part verb compounds in which meaning components such as Path, Manner, Deixis, and Endstate are all represented by distinct verbs. In other words, learners have become sensitive to the Mandarin-specific style of "event packaging". But their productivity in verb compounding goes too far: at age six and even beyond, they are still creating compounds that adults find odd, and they generally fail to reject them in a judgment task (Experiment 3).

Children's early grasp of the combinatorial structure of Mandarin VCs accords well with what is known about the acquisition of complex predicates in a few other languages. For example, learners of three closely related Germanic languages, English, German, and Dutch, produce verb-particle combinations frequently and productively from about age 2 (Behrens, 1998). Although complex predicates differ in Mandarin and Germanic languages – e.g., speakers of Germanic languages cannot combine two verbs, whereas speakers of Mandarin must do so – at a more abstract level learners of all these languages face a similar task: they must analyze conventional combinations like English *fall down* or Mandarin *diao4-xia4-lai2* 'fall-descend-come' into their components, and discover the patterns according to which these are combined.

The overall learning process in Mandarin, as in the Germanic languages, offers support for the usage-based, constructivist approach to language-learning, according to which children start out by learning items one by one in a piecemeal fashion, but gradually discover the more abstract underlying regularities or schemas that unify them, and begin to be able to use these schemas productively. At the same time, the gradualness of the learning process argues against the accuracy of the Compounding Parameter (Snyder, 1995, 2002, see §3.4.1), which predicts a more sudden overall productivity in complex predicates.

In her discussion of children's lexical development, Clark (1993, 2004) proposed three very general principles that affect the process of learning constructional regularities on the basis of the input: Transparency of Meaning, Simplicity of Form, and Productivity in Use. The principle of Transparency of Meaning states that words or constructions that are based on known roots and affixes are learned earlier than those that depend on forms that are opaque to the child. For example, the noun compound *pain-killer* is composed of two familiar roots, *pain* and *kill*, along with the relatively early-learned agentive or instrumental suffix *-er*. Recall that in Mandarin, the component verbs of RVCs and DVCs all occur as independent simple verbs as well as in compounds. So the principle of Transparency of Meaning points to a factor that learners of Mandarin could use in analyzing the composition of verb compounds.

The principle of Simplicity of Form states that the simpler a construction is – e.g., the less its root components change in its construction – the easier it is to learn. This means, for example, that English nominals derived from adjectives by adding *-ness*, such as *happiness*, are easier than those derived by adding *-ity,* such as *curiosity*, since *-ity*, but not *-ness*, often causes a stress change in the root adjective. This principle may also contribute to the early productivity of verb compounding in Mandarin. In Mandarin there is no overt morphological marking indicating the relationship between the component verbs in an RVC or a DVC; to create a verb compound, all the child needs to do is to simply combine two or three bare verbs

The principle of Productivity in Use states that in forming new words, speakers rely on the most productive option in the language with the appropriate meaning. Productivity reflects the conventional collective preferences of speakers of the language, which in turn draws on speakers' knowledge of structurally possible and available options in that language. The patterns to which children receive the most exposure are those that are the most frequent in adult speech. In Mandarin, DVCs and RVCs are the most frequent constructions for encoding motion and state-change events, as is shown by the abundant types and tokens of VCs in both the spontaneous speech data and the elicited speech data I have examined. The spontaneous speech data also reveal that children and adults are remarkably similar in the overall distribution of different semantic subtypes of VCs in their speech; thus, the most frequent subtypes of VCs in adult speech are also the most frequent in child speech. This correspondence suggests that children are highly sensitive to the frequency of different constructional schemas in the input, and use this information in building their own preferences for word formation.

So transparency of meaning, simplicity of form, and high productivity in adult speech all seem to contribute to early productivity in the use of VCs by children learning Mandarin, and these reflect mechanisms considered important in usage-based approaches to language. These factors do not, however, provide a detailed blueprint for how children cut back on productivity if they have gone too far. As we have seen, learners of Mandarin create and accept VCs that sound strange to adults' ears up to a ripe old age – 8 years and beyond. Further work will be needed to arrive at a detailed understanding of how children learn the necessary constraints.

INTERPRETING STATE CHANGE: LEARNING THE MEANING OF RESULTATIVE VERB COMPOUNDS

CHAPTER 5

5.1 Introduction

In the previous chapter, I discussed Mandarin-speaking children's production of verb compounds from a developmental perspective. Even though children begin to use verb compounds productively at an early age, it is still unclear how they interpret their meanings. According to the acquisition literature, children often understand verb meanings differently from adults even when their production seems productive and errorless (e.g., Gentner, 1978; Tomasello, 1992).

The meaning of a verb is generally assumed to be internally structured, and it is often represented as a set of semantic components combined in a certain configuration (Levin & Rappaport Hovav, 1995; Pinker, 1989; Talmy, 1985). Across languages, there is variation in how this information is "packaged" in verbs and verb-related constructions (Talmy, 1985, 2000). To learn the meaning of verbs, children have to determine which semantic elements play a role in their meanings, and to discover the patterns by which they are typically combined in the language they are acquiring (Behrens, 1998; Bowerman, 1994; Wittek, 1999, 2002). In other words, they must identify which meaning components are "conflated" in a verb's semantic representation, and which are expressed by other means, such as with particles or prepositional phrases.

Previous studies have revealed that children often misinterpret the meanings of verbs with complex semantics, such as state-change verbs (e.g., Gentner, 1978; Gropen, Pinker, Hollander, & Goldberg, 1991; Wittek, 1999, 2002). In a study of the acquisition of common cooking verbs, Gentner (1978) observed that English-speaking children between 5 and 7 years old were able to correctly associate three manner verbs, *stir*, *beat*, and *shake*, with the appropriate manner, but they tended to interpret the state-change verb *mix* as if it specified only a certain manner of motion, not a particular end state. Gentner concluded that English-speaking children have more difficulty acquiring meaning components relevant to changes of state than those relevant to the manner in which an action is performed (they have a "Manner Bias"). She claimed that English-speaking children tend to ignore the result meaning in state-change verbs. In a related finding, Gropen and colleagues (1991) demonstrated that children roughly 4 to 6 years old treat the state-change verb *fill* as if it specified only a particular action, pouring. This action may, but need not, lead to the end state of something being full. Tomasello (1992) also noted many early errors ("packaging errors", in his terms) with state-change verbs in his daughter's speech, such as the child's use of the words *clean, cook,* and *fix* not to refer to objects going from dirty to clean, uncooked to cooked, or broken to fixed, but rather to designate the characteristic action involved: wiping with a cloth, stirring in a pot, and hammering something.

Such misinterpretations of verb meanings do not seem to stem from children's failure to perceive and conceptualize the end state of state-change events. For example, in languages that encode end state with particles, such as English, children use particles to express state change before the age of two (Bowerman, 1994; Bowerman & Choi, 2001; Tomasello, 1992). Further, Slobin (1985) observes that children first apply case markers such as accusative and ergative case only to the arguments of transitive verbs that encode instances of what he calls the "Manipulative Activity Scene", a situation in which an agent brings about a physical and perceptible change of state in a patient by means of direct manipulation. Slobin (1985) also states that children's first tense/aspect markers emphasize the contrast between process and result. In other words, learners are attracted by state changes and affected objects.

In a study of German-speaking children's understanding of state-change verbs, Wittek (1999, 2002) found that children did not, in fact, totally ignore the state-change meaning in state-change verbs, but treated it as only optional rather than entailed (the "Weak Endstate" hypothesis). For example, they often interpreted verbs such as *pflücken* 'pick' and *abpflücken* 'pick off' to mean *do an action with the intention to cause something to come off.*

There seems, then, to be a paradox: children show early sensitivity to the end state of state-change events, but they have difficulty in correctly understanding the state-change meaning of state-change verbs. This mismatch between children's perception and their understanding of the linguistic encoding of state-change events suggests that they do not yet know what semantic information is encoded in state-change verbs.

How should we interpret these findings in a broader crosslinguistic perspective? Do children universally prefer to disregard or downplay the state-change component of a state-change verb's meaning, even when their language encodes state change differently from English or German? To explore these issues, this chapter examines how Mandarin-speaking children interpret the state-change meaning in RVCs. In particular, it addresses the following two questions:

(i) What meanings do children assign to RVCs as a whole?

(ii) How do children interpret the meaning of the *action* verbs (V_1) of RVCs?

5.2 Learning the semantics of Mandarin RVCs

In §2.5.2 of Chapter 2, I discussed the semantics of Mandarin RVCs and their component verbs. To recapitulate, state change can be consistently encoded in Mandarin with resultative verb compounds (RVCs), as illustrated in (73):

(73) *A1yi2* ***zhai1-xia4*** *le* *ping2guo3.*
Auntie do.picking-descend PFV apple
'Auntie picked the apple (off).'

In (73), the Mandarin counterpart of the English state-change verb *pick* or the verb-particle construction *pick off* is the resultative verb compound *zhai1-xia4* 'do.picking.action-descend'. This consists of two verbs, *zhai1* 'do.picking.action' and *xia4* 'descend'. Each verb of an RVC encodes one aspect of a causal event, the first verb (V_1) specifying the causal action and the second verb (V_2) the result. It is the V_2 that confirms the realization of a caused state change: V_1 (i.e., the simplex action verb) is moot about the possible state change, or at best only implies it (as I try to convey with glosses such as 'do.picking'). This is illustrated in (74), which – unlike its English counterpart – is perfectly grammatical:

(74) *A1yi2* ***zhai1*** *le* *ping2guo3,* *ke3shi4* *mei2* ***zhai1-xia4.***
Auntie **do.picking** PFV apple but not **do.picking-descend**
'Auntie picked the apple, but didn't pick it off.'

More generally, Mandarin contrasts typologically with English in its typical lexicalization of state change (Talmy, 2000). English has many monomorphemic action verbs (e.g., *pick*, *break*) that entail the fulfillment of a state change. If speakers want to express implied fulfillment or moot fulfillment, they must use an additional form, for example, the progressive aspect (*she was picking the apple*) or the conative construction (*She picked at the apple*). Mandarin shows the opposite pattern: monomorphemic action verbs do not in themselves entail state change and an additional form must be added to encode this meaning (see also Pederson, 2007, for a more general consideration of languages of this type).

Mandarin RVCs taken as a whole are accomplishment or achievement verbs which denote telic events (Tai, 1984), and they frequently occur with the perfective aspect marker *le*. When *le* is used with a verb that encodes an event with a clear boundary (like an RVC), it signals the completion of the event. But when the verb encodes an event with no clear boundary, *le* simply signals the termination of the action. The interaction between *le* and the Aktionsart of the verb is illustrated in sentence (73): the use of the perfective aspect marker *le* with *zhai1-xia4 le* 'do.picking.action-descend' indicates that the state change has occurred – the apple has come off. But *le* with the atelic action verb *zhai1* 'do.picking.action' as in (74) indicates only that the picking action has been performed, regardless of whether the apple has come off. In sum, *le* only signifies termination, not state change. State change is entailed only with verbs with certain Aktionsart properties (Chao, 1968; C. Li & Thompson, 1981).

5.2.1 Experiment 4: Knowledge of the meaning of RVCs and V_1s in the State-change study

What do children' know about this system? To find out, I conducted an experiment with children of different ages and a group of adult native speakers of Mandarin in Guangzhou, P. R. China.

Stimuli

In this study I used a stimulus set that was designed and created by Wittek (1999, 2002) for her study of German-speaking children's learning of state-change verbs. It consists of 16 target video clips, 4 control clips, and 2 warm-up clips, each about 50 seconds long. The target clips depict an actor manipulating an object in a certain way. Eight clips (state-change events) show a state-change event: *wake someone, extinguish candle, break plate, crack nut, kill deer, pick apple, fill cup, close door*. The other eight clips (no-state-change events) show the same causal actions, but the associated state change does not come about. For the *wake someone* event, for example:

> *State-change event:*
>
> A man is sleeping at a table. A woman comes in and holds a ringing alarm clock near his head, causing him to wake up. The man yawns and stretches his arms.
>
> *No-state-change event:*
>
> A man is sleeping at a table. A woman comes in and holds a ringing alarm clock near his head, but the man does not wake up.

Each participant watched four video clips of each type (i.e., four state-change events and four no-state-change events). No participant saw both members of a pair, for example, both *wake someone* and *do the waking action but the other does not wake up*.

The two warm-up clips were designed to familiarize participants with the task. The four control items were included to make the stimuli more diverse and to allow the experimenter to identify children with a general “yes” bias. Half the control items required a “yes” answer and half a “no” answer. For example, for a video clip showing a woman fixing a toy car, the child was expected to say “no” to a question about whether the woman had washed the car. A detailed description of the video scenes is presented in Appendix 5.1.

Participants

The participants were recruited from two kindergartens in Guangzhou, Guangzhou Blue-sky Kindergarten and the Kindergarten of the South China Agricultural University. They were mostly the same children who participated in Experiments 1 and 2 (see §4.4). Four groups of children participated, with mean ages of 2;6 (range 2;5 – 2;9), 3;6 (3;5 – 3;8), 4;6 (4;3 – 4;7) and 6;1 (5;4 – 6;10), as well as a group of adults (mean age 31); there were 10 participants in each age group. Two 2;6-year-olds and one 3;6-year-old were excluded from the analysis because they failed to give correct responses to any of the four control items, and another 2;6-year-old was excluded because she did not respond to the warm-up items. These children were replaced with children of the same age who succeeded on all the control items and warm-up items. So the total of 10 children in each age group includes only children who showed no “yes” bias.

Procedure

The task is in essence a truth-value judgment task, but it was designed for use with young children. Following Wittek's procedure, I tested each child individually in a separate room in the kindergarten. Sessions took about fifteen to twenty minutes. The child was invited to play a game with a toy puppy, who was said to be silly but eager to learn the child's language. I first invited the child to make friends with the puppy by shaking its paw and patting it. Then I asked the child whether he or she (henceforth "she") would like to help the puppy learn the child's language. All the children agreed.

To put the child at ease and to familiarize her with the task procedure, I first had the toy puppy perform two warm-up actions and try to describe them. I supplied the puppy's voice throughout the experiment. For each of these actions, the child had to determine whether the puppy had described it correctly. For example, the puppy waved its foreleg and referred to this as "waving":

(75) *Wo3 xiang3 zhe4 shi4 zhao1 shou3. Wo3 zai4 zhao1 shou3. dui4 bu2 dui4 a?*
I think this is wave hand I PROG wave hand right not right QP
'I think this is called "waving hand". I am waving my hand. Right or not?'

Or the puppy lay down on the experimenter's lap, saying:

(76) *Wo3 xiang3 zhe4 shi4 'tiao4'. xian4zai4 wo3 zai4 tiao4, dui4 bu2 dui4 a?*
I think this is jump now I PROG jump right not right QP
'I think this is called "jump". Now I am jumping, right or not?'

The child was also asked to act out the referent actions in the warm-up trials – "waving hand" for (75) and "jumping" for (76). If the child had made an incorrect judgment – saying "yes" to (76), for example – she was again asked, after she had acted out the referent action, whether the puppy had indeed performed the referent action. All the children correctly acted out the referent actions in the warm-up trials, and – if they had previously made an incorrect judgment about the puppy – they now made correct judgments.

Each of the eight target trials started with a still picture of the video clip. The experimenter pointed out the objects in the picture and mentioned their names if the child did not recognize them. Then the puppy would predict what was going to happen before the actor performed the action in the clip. The prediction always included an RVC which specified that the end state associated with the action would be achieved. For the "picking an apple" clip, for example, the puppy would predict:

(77) *Wo3 xiang3 a1yi2 yao4* ***zhai1-xia4*** *ping2guo3.*

I think auntie will **do.picking.action-descend** apple

'I think auntie will pick the apple.'

After the child watched the video clip, she was asked to judge whether the puppy had predicted correctly and then to answer two further questions, one designed to tap her understanding of the RVC as a whole and the other her understanding of the first verb (V_1) alone. Table 5.1 shows the two questions and their expected answers for the state-change and no-state-change versions of "picking an apple".

Table 5.1. Sample questions and expected responses
to state-change and no-state-change video clips

Questions	Expected response to state-change clips	Expected response to no-state-change clips
Q1: Taps the meaning of the RVC as a whole: *A1yi2* ***zhai1-xia4*** *le*[42] *ping2guo3 ma?* Auntie **do.picking-descend** PFV apple QP 'Did auntie pick the apple?'	YES	NO
Q2: Taps the meaning of the V_1: *A1yi2* ***zhai1*** *le ping2guo3 ma?* Auntie **do.picking** PFV apple QP 'Did auntie do a picking action on the apple?'	YES	YES

The eight RVCs that appeared in Q1 are shown in Table 5.2, along with the state-change/no-state-change clips with which they were paired. The V_1 of each of the RVCs, tapped in Q2, is also listed in Table 5.2.

[42] The perfective aspect marker *le* can occur in either sentence final position or verb-final position, or both. In this study, *-le* is used verb-finally.

Table 5.2. RVCs tested in the *State-change* experiment

	Events	RVCs		V_1 of the RVCs	
1	wake man	*nao4-xing3*	'make.noise-be.awake'	*nao4*	'make.noise'
2	break plate	*chui2-sui4*	'hammer-be.smashed' (smash with a hammer)	*chui2*	'hammer'
3	fill cup	*dao4-man3*	'pour-be.full'	*dao4*	'pour'
4	crack nut	*jia2-sui4*	'hold.tightly-be.in.pieces'	*jia2*	'hold.tightly'
5	kill animal	*da3-si3*	'shoot-die'	*da3*	'shoot'
6	pick apple	*zhai1-xia4*	'pick-descend' (pick off)	*zhai1*	'pick'
7	close door	*guan1-shang4*	'close-ascend' (close up)	*guan1*	'close'
8	extinguish candle	*chui1-mie4*	'blow-be.extinguished'	*chui1*	'blow'

To insure that children of around 2;6 years (my youngest age group) knew all the component verbs of the RVCs, i.e., the V_1s and the V_2s individually, I checked the uses of these verbs in the speech of the children in the CHILDES Beijing corpus and the Fang corpus (see Chapter 4 for background information on these corpora). I found that these verbs occurred in the daily vocabulary of most of the children sampled.[43]

5.2.2 Results

Interpretation of RVCs as a whole

Let us first analyze the participants' interpretations of the RVCs as a whole, i.e., their responses to the first question (Q1), such as, "Did auntie pick the apple?". The total number of responses to Q1 was 400 (= 10 subjects × 2 state-change conditions × 4 clips × 5 age groups). Figure 5.1 shows the percentage of "yes" responses broken down by age. A "yes" response to a state-change clip means that the child correctly interprets the RVC as entailing a state change. A "yes" response to a no-state-change clip, in contrast, means that the child incorrectly thinks that the RVC applies to the scene even though the state change does not come about. (Recall that children with a general "yes" bias had been excluded.)

[43] The English counterpart of *jia2* 'hold.tightly' may not be in the everyday vocabulary of young English learners, but *jia2* is a common verb for Mandarin children, probably because it is used for the action of grasping and holding food with chopsticks.

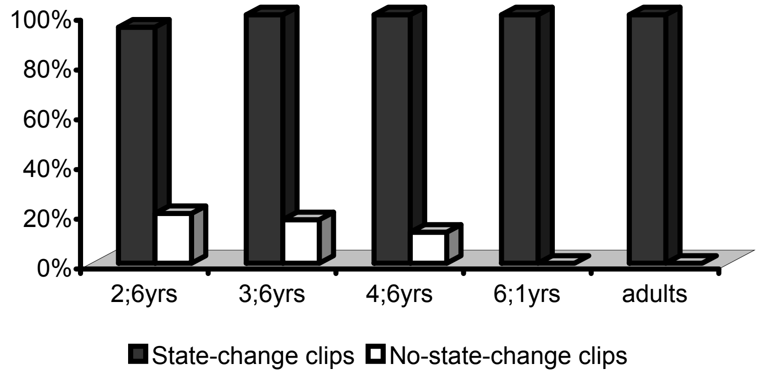


Figure 5.1. Percentage of "yes" responses to Q1: interpretation of an RVC as a whole, by age

Figure 5.1 reveals that all age groups gave nearly 100% "yes" responses to the state-change clips, accepting RVCs as descriptions of these clips, while to the no-state-change clips they gave "no" responses 80-100% of the time, rejecting RVCs when the state change did not occur. The youngest three age groups (2;6-, 3;6-, and 4;6-year-olds) gave some inappropriate "yes" responses (e.g., 20% for the 2;6-year-olds), but this gradually dropped off with increasing age.

To determine whether the differences in responding across age, and to the different clip types (i.e., state-change vs. no-state-change) are significant, I needed an appropriate statistic analysis. ANOVA might come to the reader's mind as a familiar test of the contribution of the independent variables, here *age* and *state-change condition*, but it is a parametric statistical method, suitable only for data involving continuous and non-categorical variables. The present data set does not satisfy the assumptions of this model since it involves frequency counts of binary categorical dependent variables, i.e., "yes" or "no" responses. We need a non-parametric statistic that can deal with categorical frequency variables. A suitable method for this type of data is a Classification and Regression Tree (CART) analysis (Baayen, 2008; Goldstein, 2003; Venables & Smith, 2002).

CART is a non-parametric analysis that makes no assumptions about the underlying distributions of the predictor variables. It is a robust data-analysis technique that automatically searches for important patterns and relationships and uncovers hidden structure in highly complex data. It is suitable for categorical data with binary dependent variables (such as correct or incorrect response, success or failure, heads or tails, direct object construction or prepositional object construction). This technique predicts the probability of a given binary outcome given a set of predictors (i.e., the independent variables), and generates tree-based models reflecting this structure. These models are good at representing complex interactions in the data.

Tree-based models operate by recursively partitioning a dataset into two subsets (i.e., making successive binary splits). Each split is based on the value of a single predictor variable. The choice of the predictor variable and its value for each split is based on an exhaustive search of all possible divisions of the data. The aim of each split is either to maximize the homogeneity of the groups in the case of nominal or ordinal responses (i.e., classification) or to best separate low and high values in the case of continuous response variables. The algorithm continues splitting the subsets of the data until they are maximally homogeneous or contain too few observations to continue. Finally the constructed tree is pruned using cross-validation, that is, the tree is simplified without sacrificing goodness-of-fit. The software that incorporates the CART technique used for this analysis is the R statistics program (version 2.1.1). It was downloaded from http://cran.xedio.de (cf. Goldstein, 2003; Venables & Smith, 2002).

The response variable that the CART analysis attempted to predict was whether the participants produced a “yes” or “no” response to Q1, which tapped the meaning of each RVC as a whole (e.g., “Did auntie pick the apple?”). The predictor variables were the two independent variables *age* (5 levels: 2;6-, 3;6-, 4;6-, 6;1-year-olds, adults) and s*tate-change condition* (2 levels: state-change clips and no-state-change clips). I entered the raw frequencies of “yes” and “no” responses from each participant in each age group into the R program. The CART analysis generated the tree diagram shown in Figure 5.2.

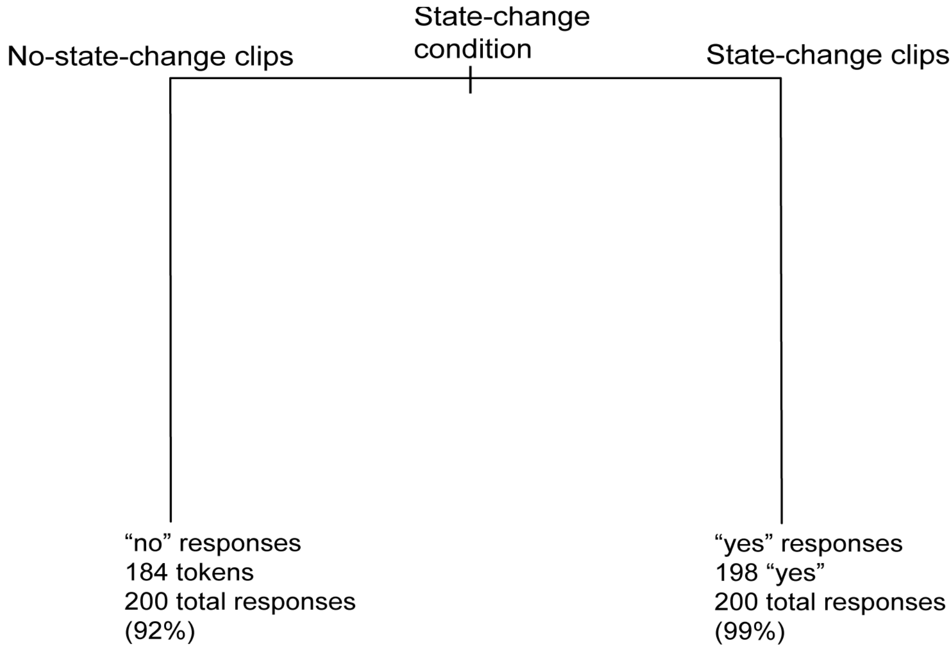


Figure 5.2. CART analysis of responses to Q1 (interpretation of an RVC as a whole) by state-change condition and age

There is a single split, based on the predictor variable state-change condition *(labeled at the top of the split). The two levels of this predictor (e.g.,* no-state-change *clips vs.* state-change *clips) are labeled on the branches of the split. The terminal nodes of the branches are labeled according to the relevant level of the dependent variable ("yes" or "no" responses). Below each terminal node we see the raw number of responses falling under that level, along with the total number of responses and (in parentheses) the percentage. For example, the total number of possible responses to Q1 for the state-change subset of clips (right-hand branch) is 200 (= 10 subjects × 4 clips ×5 groups). Of these there were 198 "yes" responses, which represent 99% of the total.*

Figure 5.2 shows the overall structure of the data. The data are divided into two large groups on the basis of the two levels of the independent variable *state-change condition*. This means that the independent variable *state-change condition*, which is the only node in Figure 5.2, is the best predictor of the response patterns of the participants: the participants tended strongly to give “no” responses to Q1s about the no-state-change events, indicated by the left branch in Figure 5.2, and overwhelmingly to give “yes” responses to Q1s about the state-change events, indicated by the right branch in Figure 5.2. This pattern is, statistically speaking, consistent across all age groups, despite the occasional occurrence of “yes” responses to Q1s for the no-state-change clips among the younger children (Figure 5.1). This is shown by the fact that the CART tree did not further group the responses under the other independent variable, *age*. The children and the adults were, then, similar in their responses to Q1s: they were all sensitive to whether a certain result was achieved, and they knew from an early age (2;6 years) that the state-change meaning is critical to an RVC as a whole. If no state change occurs, it is not appropriate to use an RVC even if an action has taken place that might be expected to lead to this state change.

Interpretation of action verbs (V_1 of an RVC)

We have just seen that the children clearly understand the state-change meaning of an RVC as a whole. But what do they understand about the role of the component verbs within the RVC? As discussed in Chapter 2 (§2.5.2), Mandarin monomorphemic action verbs (V_1 of an RVC, e.g., *zhai1* 'do.picking' in *zhai1-xia4* 'do.picking-descend') do not in themselves entail a state change; the state-change meaning comes from the addition of the second verb. Do children know that the V_1s do not entail a state-change meaning? In this section, I analyze the responses to Q2, the question that taps the meaning of the first verb of an RVC, e.g., *A1yi zhai1 le ping2guo3 ma?* 'Auntie do.picking LE apple?' (did auntie do a picking action on the apple?). The total number of responses to Q2 was 400 (10 subjects × 2 state-change conditions × 4 clips × 5 age groups). Figure 5.3 presents the percentage of "yes" responses to these questions from all the participant groups.

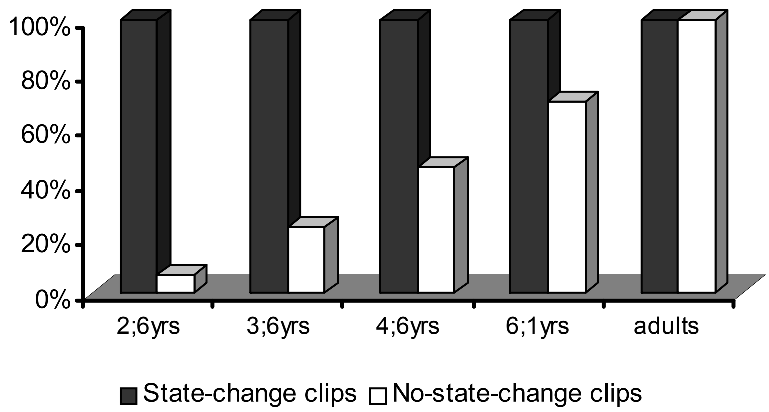


Figure 5.3. Percentage of "yes" responses to Q2: interpretation of V_1s, by age

A "yes" answer was expected regardless of whether Q2 was asked about a state-change or a no-state-change clip, since the V_1 of an RVC encodes only the action, whether or not it leads to a state change. On the state-change clips the children's responses were very similar to those of the adults: they said "yes" nearly 100% of the time. But on the no-state-change clips their responses were very different. The adults gave the expected "yes" responses 100% of the time, recognizing that the action denoted by V_1 had taken place even though the associated result had not come about. The children, in contrast, very often said "no", apparently thinking that for a V_1 to be used felicitously the result also had to have taken place. In other words, the children incorrectly treated V_1 as entailing a state change.

To find out how the two independent variables, *age* and *state-change condition,* contribute to the response patterns, I again used the CART technique, this time for Q2. The raw frequencies of "yes" and "no" responses to Q2 from each participant for each clip were entered into the R program and computed for the CART analysis. The following CART tree was generated.

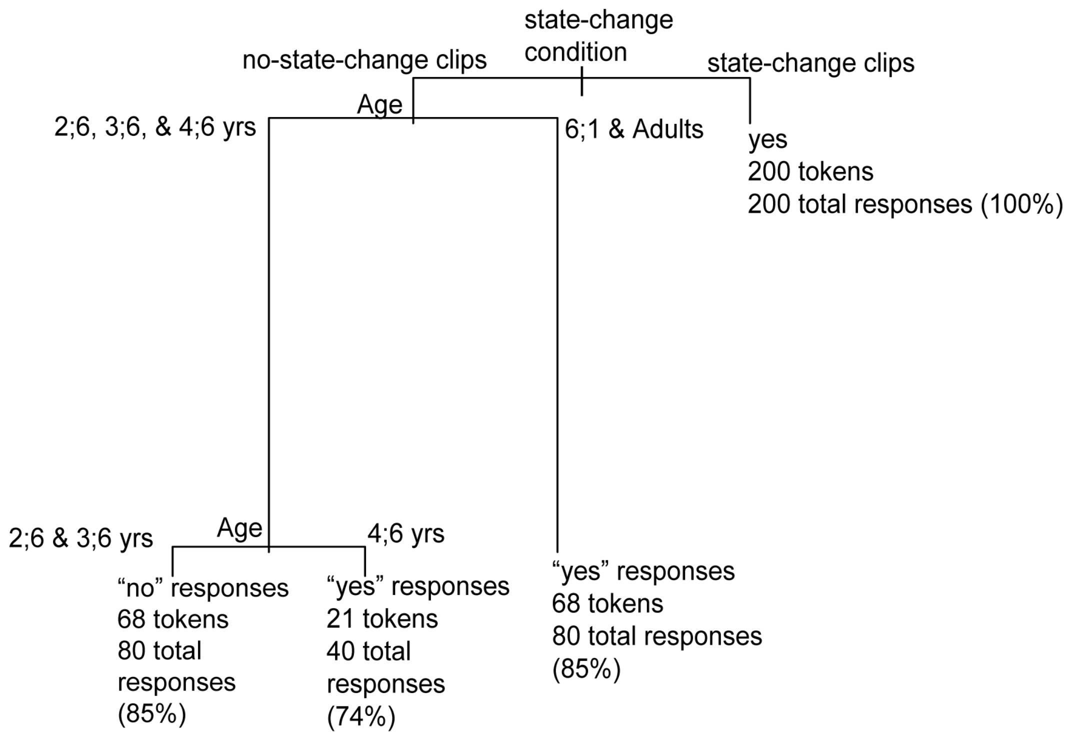


Figure 5.4. CART analysis of the responses to V_1s by age

At the top of each split is a label for the predictor variable responsible for the split, with the relevant level(s) of this predictor indicated on the two branches. The terminal nodes of all the branches are labeled according to the relevant level of the dependent variables ("yes" or "no" responses). Below each terminal node we see the raw number of responses falling under that level, along with the total number of responses and (in parentheses) the percentage this represents. For example, the total number of responses for the 2;6- and 3;6-year olds in the no-state-change condition (lower left terminal node) is 80 (=10 subjects × 4 clips × 2 groups). Of these there were 68 "no" responses, which represents 85% of the total.

The results shown in Figure 5.4 can be interpreted as follows. First the data are divided into two large groups on the basis of the two levels of the independent variable *state-change condition*. Then the data from the no-state-change clips (left branch) is further subdivided into two smaller groups on the basis of *age* (2;6-, 3;6-, and 4;6-year-olds vs.

6;1-year-olds and adults). Then the data from the three youngest age groups are further subdivided on the basis of *age* again (2;6- and 3;6-year-olds vs. 4;6-year-olds).

In a CART analysis, the order of the node splitting indicates the relative importance of the predictor variable in determining the data patterns. The CART tree in Figure 5.4 shows that the independent variable *state-change condition*, shown at the first split node, is the primary predictor of the participants' responses to Q2, and *age*, shown at the second and third split nodes, is the secondary predictor. This means that participants of all ages tended to differentiate their "yes" and "no" responses primarily on the basis of clip type: the state-change clips attracted significantly more "yes" responses (100%) than the no-state-change clips. On the no-state-change clips, the 2;6-, 3;6-, and 4;6-year-olds differed significantly from the 6;1-year-olds and the adults in their overall "yes" responses, as shown by the second split, with the two oldest groups giving significantly more "yes" responses than the three youngest groups. The final split at the lower left of the figure shows that of these youngest groups, the oldest (4;6-year-olds) gave significantly more "yes" responses than the two youngest (2;6- and 3;6-year-olds).

To summarize, the children are similar to the adults in their answers to Q2 on the state-change clips: they recognized that the action specified by V_1 has occurred. But they differ from the adults in responding to the no-state-change clips: if the state change does not come about, they think that the action specified by the verb has not occurred. This contrast is further illustrated in Figure 5.5, which shows the responses to both Q1 (the interpretation of the RVCs as a whole) and to Q2 (the interpretation of the V_1s) only for the critical no-state-change events. This figure shows that the two youngest age groups treat questions tapping the interpretation of the V_1 and the RVC as a whole very similarly: when no state change is realized, they reject not only the use of the RVC, but also the use of the action verb, V_1. That is, they treat action verbs just as they treat RVCs – as if they entail a state change.

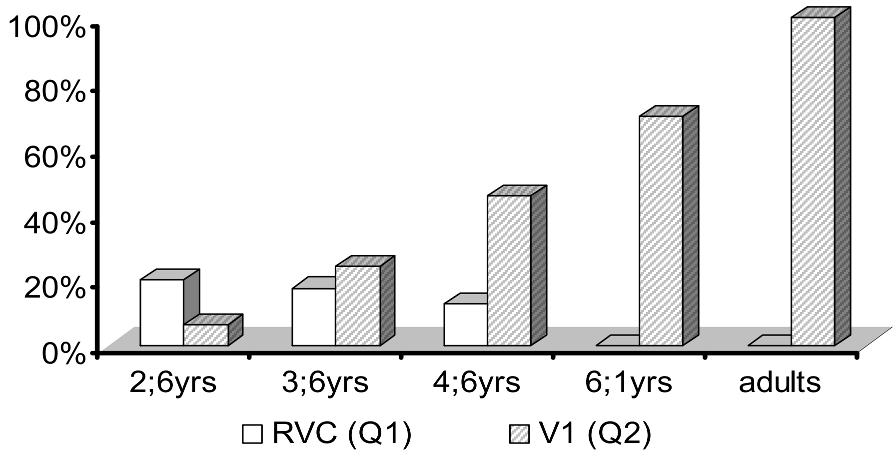


Figure 5.5. Percentage of "yes" responses to Q1 and Q2
for the no-state-change clips, by age

Analysis of the misinterpreted V_1s broken down by clip

We have just seen that learners of Mandarin tend to interpret action verbs as state-change verbs, but is this true across the board, or do they treat different V_1s differently? To find this out, I compared their responses to Q2 across the eight no-state-change clips. In other words, I included *clip* as an independent variable in addition to *age* and *state-change condition.*

Figure 5.6 shows the proportions of "yes" responses given to Q2 (about the interpretation of V_1), broken down by video clip. Recall that on a no-state-change event, a "yes" response to a question such as "Did auntie do a picking action on the apple?" is correct – the action has taken place even if the state change did not come about.

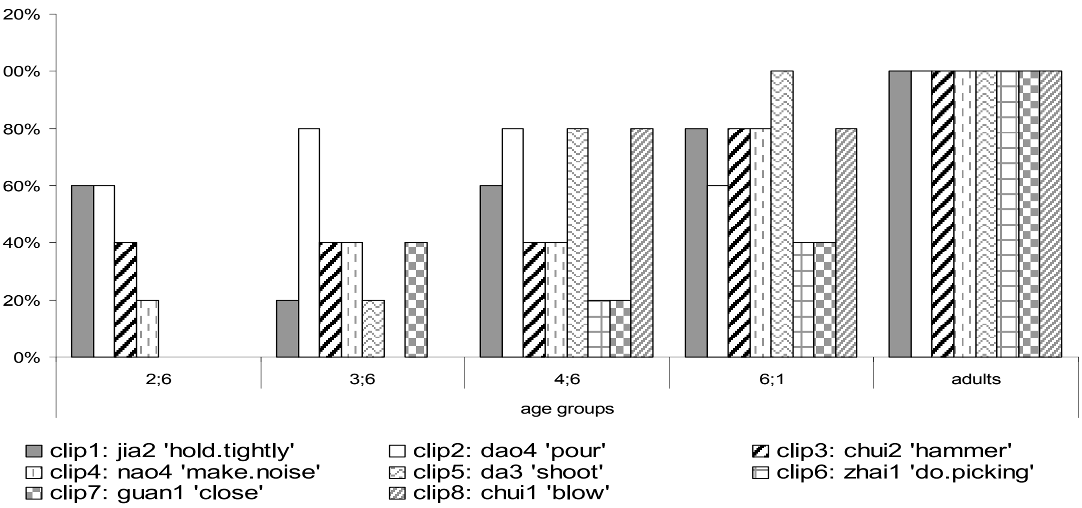


Figure 5.6. Percentage of "yes" responses to Q2 (interpretation of V_1s)
for the no-state-change clips, by age and clip

The adults gave uniform “yes” responses to all the clips, but the children responded differently to different verbs. In general, they gave more “yes” responses to the first five verbs (counting bars from the left in each age group): *jia2* ‘hold.tightly’, *dao4* ‘pour’, *chui2* ‘hammer’, *nao4* ‘make.noise’, and *da3* ‘shoot’, and fewer to the three remaining verbs, *guan1* ‘do.closing’, *chui1* ‘blow’, and *zhai1* ‘do.picking’. The youngest children, 2;6-year-olds, for example, gave some correct “yes” responses to *jia2, dao4, chui2,* and *nao4*, but not to *da3, guan1, zhai1*, and *chui1*.

This suggests that the children were more likely to interpret the second set of verbs as entailing a state change (hence, as the event’s not having occurred if the state change did not come about). That is, they did not treat all the action verbs indiscriminately as entailing a state change, but were sensitive to the strength of the implicature of state change meaning in the verbs. Three adult native speakers of Mandarin commented that they would assume that *guan1* ‘close’, *chui1* ‘blow’, *da3* ‘shoot’, and *zhai1* ‘do.picking’ entail the associated state change unless this is explicitly canceled. Thus, if someone says only *Wo3 guan1 le men2* ‘I do.closing PFV door’ (I did closing of the door), they would assume that the door ends up closed unless the speaker adds something like *dan4shi4 men2 mei2 guan1-shang4* ‘but door not close-up’ (but the door did not close). These findings support Tai’s (1984) observation that the strength of the implicature of state change varies across Mandarin action verbs: he notes, for example, that the verb *sha1* ‘do killing action’ has an implicature stronger than that of many other action verbs.

For further analysis, I divided these eight verbs into two sets: the *weak-state-change-implicature* verbs (including *jia2, dao4, chui2,* and *nao4*) and the *strong-state-change-implicature* verbs (including *guan1, chui1, da3*, and *zhai1*). This grouping reveals a clearer distinctive response pattern among the children, as shown in Figure 5.7.

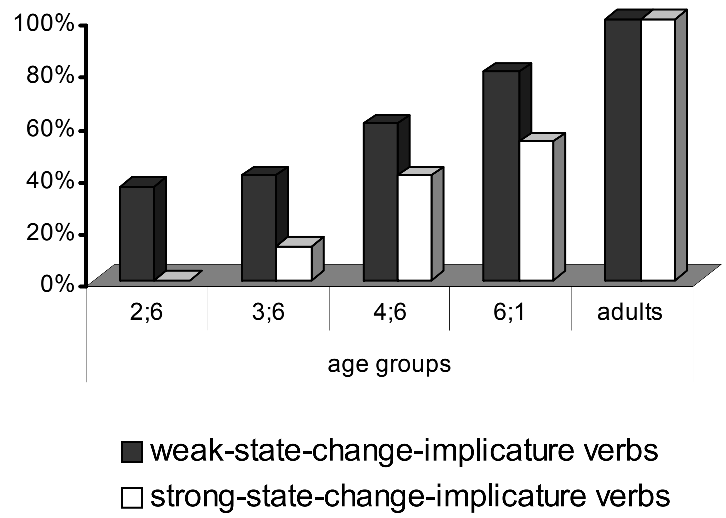


Figure 5.7. Percentage of "yes" responses to Q2 (interpretation of V_1s) for the no-state-change clips, by strength of implicature (weak vs. strong) and age

There are more correct "yes" responses for the "weak-state-change-implicature verbs" (dark bars) than the "strong-state-change-implicature verbs" (white bars). This pattern is consistent across all the children's age groups, although there is a gradual increase in correct responses to verbs of both types. This result suggests that the stronger a verb's implicature of state change, the longer it takes for children to learn that it does not actually entail a state change.

To see whether the response patterns differ significantly across the age groups, I conducted a CART analysis that included the individual clips as a second independent variable in addition to *age* (the independent variable *state-change condition* is now irrelevant, since only the no-state-change clips are analyzed). The CART analysis generated the following diagram.

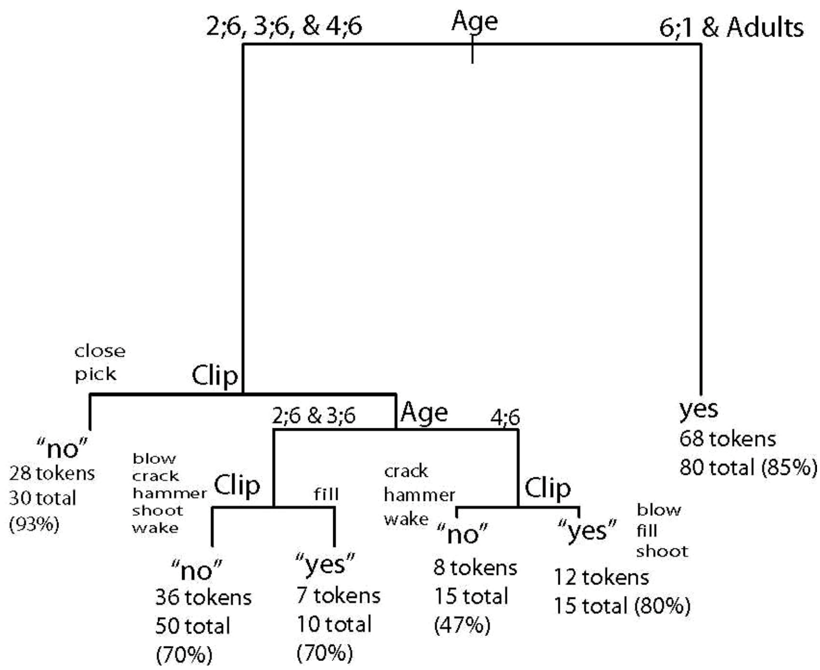


Figure 5.8. CART analysis of the responses to Q2 (interpretation of V_1s) for individual clips in the no-state-change condition, by age

The predictor variables (age and clip) are labeled at top of the splits for which they are relevant. The first predictor variable, age, is at the top of the first split. At each branch of the splits are the labels of the levels of the relevant independent variable (age group or clip). The terminal nodes of all the branches are labeled according to the relevant level of the dependent variable ("yes" or "no" responses). Below each terminal node, the raw number of responses falling under that level is shown, along with the total number of responses and (in parentheses) the percentage this represents. For example, the total number of responses for the youngest three age groups on the clips "close" and "pick" is 30 (= 3 age groups × 2 clips × 5 responses per clip).[44] *Of these there were 28 "no" responses, which represent 93% of the total of 30.*

According to Figure 5.8, there are significant effects of both age and clips on the responses to Q2 for the no-state-change clips. The data are first divided into two large groups on the basis of age, with the adults and the oldest child group responding with a correct "yes" significantly more often than the three youngest age groups. The data from the three youngest age groups are then subdivided on the basis of clips: six of the clips received significantly more correct "yes" responses than the other two, with the two most difficult clips being "close door" and "pick apple". The six easier clips are then further split on the basis of age, with the 4;6-year-olds giving significantly more correct "yes" responses than the 2;6- and the

[44] Recall that of the total of eight no-state-change clips, each child watched only four, since no child watched both a state-change event and its no-state-change counterpart, e.g., both blowing out a candle and blowing at a candle without extinguishing it (cf. §5.2.1). So the total number of responses for each video clip is 40 (= 4 state-change clips × 10 subjects), and for each of the eight no-state-change clips taken individually there are 5 responses (= 40/8). The total number of responses from all age groups is 200 (= 5 age groups × 4 state-change clips × 10 responses).

3;6-year-olds. Each of these two groups (4;6 vs. 2;6 and 3;6) are then subdivided on the basis of clips: for the two youngest age groups the “fill a cup” clip received significantly more correct “yes” responses than other five clips (its V_1 is *dao4* ‘pour’, see Table 5.3), while for the 4;6-year-olds the “shoot an animal” and “blow out a candle” clips joined the “fill a cup” clip in receiving significantly more correct “yes” responses than the remaining clips (“crack a nut”, “break a plate”, and “wake someone”).

The CART tree analysis shows that the children did not treat all the V_1s as equally entailing a state change. Rather, they were remarkably sensitive to the strength of implicature of state change in different verbs, and they approached the adult-like interpretation in a stepwise fashion. The learning pattern can be represented schematically as in Figure 5.9:

– state-change interpretation → + state-change interpretation

weak-state-change-implicature verbs → strong-state-change-implicature verbs

pour (V_1 for ‘fill’ event) /*blow/shoot* < *crack/hammer* (V_1 for ‘break’ event) / *wake* < *close/pick*

Figure 5.9. The interpretation of the state-change implicature of V_1s

(Note: Mandarin verbs are represented by their English glosses for convenience. The symbol “<” indicates the order of acquisition: verbs to the left are correctly interpreted as not entailing a state change earlier than verbs to the right.)

The existence of a continuum in the lexicalization of state change in a language is not unique to Mandarin. Based on his analysis of English verbs, Talmy (2000) claimed that the implicature associated with implied-fulfillment verbs follows a cline. For example, the verbs in the sentences *He choked/stabbed/strangled/drowned him* show an increasingly strong implicature of the realization of the state change from alive to dead: *choke* and *stab* imply death only weakly; *strangle* entails death for some speakers but not for others; and *drown* clearly entails death and is therefore termed an “attained fulfillment verb” by Talmy. Mandarin monomorphemic action verbs, i.e., implied-state-change verbs and moot-fulfillment verbs, follow a similar cline, which can be schematized as in Figure 5.10, together with comparable English examples from Talmy (2000):

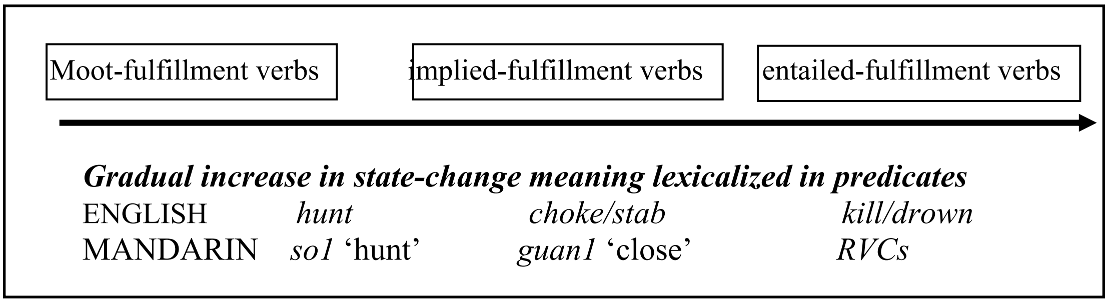


Figure 5.10. A cline of strength of state-change implicature in English and Mandarin verbs

Moot-fulfillment verb: does not in itself specify any state change
Implied-fulfillment verb: implies a likely state change
Entailed-fulfillment verb: lexicalizes a state change

In sum, Talmy's proposal that there is a continuum in the lexicalization of state change in English verbs finds an interesting echo in the Mandarin acquisition data: learners of Mandarin are remarkably sensitive to the state-change implicature in the V_1s of Mandarin RVCs, and come to understand that this state change is not entailed earlier for weak-state-change-implicature verbs than for strong-state-change-implicature verbs.

5.3 Discussion and conclusions

Mandarin-speaking children differ from learners of English and German in their interpretation of state-change verbs. Recall that learners of English and German often incorrectly treat the state-change meaning of state-change verbs (e.g., *pflücken* 'pick') as only optional, whereas in fact it is entailed (Gentner, 1978; Wittek, 1999, 2002). Mandarin children, in comparison, have less difficulty figuring out that a state-change meaning is crucial to certain predicates: from at least 2;6, they accept the use of an RVC only if a state change is realized. The morphologically and semantically complex nature of RVCs does not seem to hinder them from attaining a correct interpretation of the state-change meaning.

But this early acquisition of the meaning of RVCs is only superficial. Mandarin learners do not in fact understand the way meaning is packaged in an RVC: they incorrectly treat the action verb (V_1) as entailing a state change. This interpretation is rather persistent, and is found even among children as old as age six. So learners of Mandarin have the opposite problem from learners of English and German: they often incorrectly treat the V_1 of an RVC as if it entails a state-change, although it does not!

This crosslinguistic variation cannot be accounted for by invoking the perceptual salience of either manner or result for children, since learners of German and Mandarin behave differently. In particular, the Manner Bias Hypothesis and the Weak Endstate Hypothesis (see §5.1) do not explain the acquisition of Mandarin, since, as my study shows, (a) Mandarin children do not ignore or downplay the entailed state-change meaning in RVCs, and (b) they incorrectly interpret action verbs (V_1s in RVCs) as entailing a state change.

Learners of different languages thus show different learning problems. This suggests that the acquisition of verb meaning is influenced by the way the verbs of the target language characteristically package information. In Mandarin, the consistent strategy of encoding action and state change separately, each with its own verb in an RVC, may help children to understand the entailed state-change meaning of these compounds from a young age. But it takes Mandarin children a long time to correctly assign the action meaning to V_1 and the confirmation of state change to V_2. During this learning process, the children show remarkable sensitivity to the subtle strength of implicature of state change in the action verbs, treating verbs with a strong state-change implicature as more likely to entail a state change than those with a weak state-change implicature.

To conclude, children acquiring different languages are faced with different lexicalization puzzles, and this crosslinguistic variation leads to different learning patterns. It seems to be easy for Mandarin-speaking children to learn that RVCs entail a state-change meaning, but they have trouble determining exactly where the state-change meaning is encoded: in V_1, V_2, or the RVC as a whole.

LEARNING TO ENCODE AND CATEGORIZE "CUTTING AND BREAKING" EVENTS

CHAPTER 6

6.1 Introduction

Up to now I have been exploring the compositional structure of verb compounds in adult and child speech, and my attention to meaning has been purely at the constructional level – e.g., how are "Manner", "Path", and "Result" expressed, and where is "State change" encoded? In this chapter I turn to finer-grained questions of verb semantics, asking what children know about the use and meaning of the specific verbs that, taken together, form compound verbs in Mandarin. I investigate this question using a data set already introduced in Chapter 4: child and adult descriptions of a set of videotaped "cutting and breaking" (C&B) events.

Recall that a C&B event is typically encoded with an RVC in Mandarin, with the first verb labeling the action of the complex event and the second labeling the result of this action. This was illustrated by example (62) in §4.4.2, repeated here for convenience as (78):

(78)	*Ta1*	***qie1-duan4***	*le*	*shen2zi.*
	He	**cut with single-bladed instrument-be broken**	PFV	rope
	'He cut the rope.'			

Here, the first verb of the compound, *qie1*, encodes the action carried out by the agent, and the second verb, *duan4*, encodes the result state. But in addition to these abstract constructional meanings, the verbs carry much more specific information: the action specified by *qie1* is done with a single-bladed instrument, while the state specified by *duan4* is one in which a long object is severed crossways.

In this chapter, I focus on the following questions about such verbs:

(i) What categories of events do C&B action and result verbs pick out, and to what extent do children's semantic categories of C&B events correspond to those of adults? This is a question about the *extension* of C&B terms in the speech of speakers of different ages – what kinds of events are the terms applied to?

(ii) What semantic features are critical to the use of Mandarin C&B verbs, and how do children learn these features? This is a question about the *intension* of the terms – the mental representations of meaning that govern how speakers use the words. For example, for *qie1* – V_1 in the compound *qie1-duan4* in (78) – the use of a single-bladed instrument is a defining feature of the verb's meaning, and it is responsible for a systematic distinction made by adult speakers between C&B events involving single-bladed instruments like knives and those involving double-bladed instruments like scissors.

The chapter is organized as follows. Section 6.2 reviews some previous studies of children's acquisition of the meanings of C&B verbs. Section 6.3 presents an analysis of the action verbs and result verbs elicited using the Kids' Cut & Break stimulus set described in §4.4.2, focusing on how the stimulus events are categorized by these verbs, and trying to determine the semantic features that may account for these patterns. In §6.4 conclusions are drawn regarding children's learning of the verbs' meanings.

6.2 Previous studies of children's acquisition of cutting and breaking verbs

Previous acquisition studies have shown that children learning different languages have some problems identifying the semantic categories picked out by the C&B predicates in their language. For example, many overextension errors have been observed in the speech of learners of English, as shown in the following examples (Bowerman, 2005):

(79) Overextensions of ***break*** to flat, flexible objects:

1;8	***Break*** *it.*	(Peeling a cooked noodle apart.)
2;11	*Don't* **break** *my coat.*	(As someone pulls on the back of her coat.)

(80) Overextensions of ***cut*** to instruments lacking a "blade":

1;10	*Daddy* **cut** *ice.*	(Watching F break ice cubes into chips with a rolling pin.)

2;1 *Me **cutting**.*

(Pulling pieces of peach apart with her fingers.)

7;6 *Hey! I was about to **cut** mine!*

(Interrupted while getting ready to crack her nut with a hammer.)

Bowerman notes that children tend to overextend *break* or *broken* to events involving tearing or the torn state of a variety of two-dimensional, flexible objects, such as a magazine page, a piece of chewed baloney, a playing card, a towel, and a book. They also overextend these words to events involving the separation or separated state of objects designed to be separated, such as opening a safety pin or broach, two magnets that have come apart, and a picture of a boy assembling pieces of a model car. Evidently it is not easy for children to work out the criteria associated with C&B predicates and to establish the boundaries of the events they pick out; even children as old as seven are still making mistakes.

Similar overextensions have also been documented in experimental situations. Schaefer (1979) studied English-speaking children's semantic knowledge of five C&B verbs – *cut, tear, open, peel*, and *break* – with a picture-sorting task. The children, ranging from 4;4 to 5;2, were asked to go through a pack of colored photographs and to decide, for each picture, whether or not it showed someone "cutting" something (or, in additional sortings, "tearing", "breaking", etc.); a group of adults performed the same task. Children's judgments differed from those of adults: whereas the adults consistently assigned most of the pictures to just one of the five verb categories, children tended to assign them to more than one. For example, a child might judge that a picture showing the tearing of paper was an instance not only of *tear* but also of *cut, open,* and *break*; similarly, a photo showing the cutting of an orange with a knife was judged to be an instance not only of *cut*, but also of *open, peel,* and *break*. The most robust assignments, however, i.e., the classifications shared by the most children, were always to the only or near-only category deemed applicable by adults.

Schaefer suggests that the differences between the children and the adults reflect differences in the weight of the features they assign to the instrument, object properties, and manner of action shown in the pictures. For example, the feature "instrument" (i.e., the type of instrument) was weighted disproportionately heavily by the children: they often judged pictures showing actions with a knife as instances of "cutting" irrespective of how the knife was used (e.g., also for peeling fruits and stabbing a board with the tip of knife). Adults were more particular about how the knife was applied. Schaefer proposes that category formation is a gradual process of arriving at the appropriate weighting of the relevant semantic features that define a category.

Pye (1994) studied the extensions of ‘break’ verbs in several disparate languages – English, K’iche’ Mayan, and Mandarin. He found considerable crosslinguistic variation in the semantic features determining the makeup and boundaries of verb classes. For example, he showed that the properties of the affected object are an important factor in the choice of verbs in Mandarin: the verb *duan4* ‘be broken’ is used for breaking long objects like sticks and ropes crossways, but the verb *puo4,* also meaning ‘be broken’, is used for breaking plates and clothing. In K’iche’ Mayan, different verbs are used for events of breaking hard things, soft things, long/flexible things, and hollow things. Other factors that play different roles in different languages include force, manner of separation, and degree of resistance. The crosslinguistic variation established by Pye led him to propose that the meaning of ‘break’ verbs is language-specific.

In a follow-up acquisition study, Pye, together with Loeb and Pao (1996), examined the use of C&B verbs in an action-description task with 3- to 5-year-old learners of English, Mandarin, and K’iche’. Like Schaefer, they found that, in each language, children differed from adults in the range of events to which they applied their verbs. For example, many English-speaking children used *break* to describe events of tearing paper by hand, while adults never did. Pye et al. concluded that learners have to construct the meanings of C&B verbs by observing multiple uses of the words, and working out the semantic categories that could account for the observed extension in their own language.

In Pye et al.’s study learners of Mandarin made many interesting overextensions in their use of C&B verbs. For example, they used a variety of verbs to describe the event of tearing a piece of paper by hand (*si1* ‘tear, rip’, for adults), including *jian3* ‘cut with a double-bladed instrument’, *qie1* ‘cut with a single-bladed instrument’, *puo4* ‘be broken’, and *huai4* ‘be broken’. Some children also overextended *duan4* ‘be broken (of linear object)’ to flat objects like paper. But this pioneering study leaves many open questions. For example, Pye et al. examined only a limited set of C&B events, and they did not report the verbs that the adults used, so it is hard to determine exactly how the children differed from them. They also did not distinguish systematically between C&B action verbs in Mandarin, such as *jian3* ‘cut with a double bladed instrument’, and C&B result verbs, such as *duan4* ‘be broken (of linear object)’. From an adult native speaker’s perspective, both *jian3* and *duan4* can often be applied to the same event, such as cutting a rope with a pair of scissors: the first as V_1 and the second as V_2 in the RVC *jian3-duan4* ‘cut with double blade-be broken (of linear object)’. Failure to discriminate between C&B action verbs and C&B result verbs may lead to underestimation of children’s semantic knowledge.

In Chapter 4 I reported some of my own work on Mandarin-speaking children’s learning of C&B verbs, focusing there on productivity in verb-combining (see §4.4.2). The data – elicited descriptions of C&B events – were collected using a set of video clips developed by Bowerman, Majid, and Erkelens (2003; Erkelens, 2003) for studying semantic development crosslinguistically. Erkelens (2003) used these clips to investigate the acquisition of C&B verbs in learners of Dutch age 4 and 6 (see also Bowerman, Majid, Erkelens, Narasimhan, & Chen, 2004). She found that Dutch children became sensitive to language-specific semantic features by at least 4;6 years of age (the youngest children she tested). For example, they honored the distinction – obligatory in Dutch (and in Mandarin too, as we shall see) – between events of cutting with a single-bladed instrument such as a knife (*snijden*) and cutting with a double-bladed instrument such as scissors (*knippen*). Erkelen’s study serves as an immediate precursor to the analyses I report in the present chapter, where I pursue children’s acquisition of language-specific semantic groupings and distinctions in the C&B domain down to a much younger age.

6.3 Analysis of the semantic categorization of cutting and breaking events in Mandarin

In Chapter 4 I showed that from around 2;6, children typically describe C&B events with RVCs that combine an action verb and a result verb. In other words, they encode both the action and result at the same time. Since the data set introduced in Chapter 4 covers a wide range of C&B events, and contains very systematic uses of C&B verbs, it is ideal for an analysis of the semantic categorization of C&B events. Recall that the participants were four groups of children with mean ages of 2;6 (age range 2;5 – 2;9), 3;6 (3;5 – 3;8), 4;6 (4;3 – 4;7) and 6;1 (5;4 – 6;10), and a group of adults (mean age 31), with 10 participants in each age group. The stimulus events are shown again here in Table 6.1. By looking at which verbs are used for which events in the speakers’ descriptions, I can see how Mandarin speakers of different ages categorize these events on the basis of their implicit semantic knowledge of C&B verbs. I conducted two major types of analysis. I will first present a descriptive analysis of the overall response patterns, and then show the results from a correspondence analysis

(Greenacre, 1984) of my data (J. Chen, 2007; Majid, Bowerman, van Staden, & Boster, 2007; Majid, van Staden, Boster, & Bowerman, 2004).

Table 6.1. Complete list of C&B stimulus events

NO.	Target C&B events
1	Cutting a piece of paper with scissors
2	Breaking a twig by hand
3	Cutting a slice of bread with a knife
4	Tearing a piece of paper along a knife
5	Tearing a piece of cloth by hand
6	Cutting nails with a nail clipper
7	Breaking a bar of chocolate by hand
8	Cutting a piece of cake with a piece of a broken pot
9	Cutting an egg in slices with a wire egg cutter
10	Breaking a pot with a hammer
11	Cutting a twig off a tree with a knife
12	Cutting a nail off with a pair of pliers
13	Cutting cardboard with a knife
14	Tearing a slice of bread in two pieces by hand
15	Cutting hair with scissors
16	Tearing open a plastic bag by hand
17	Cutting a banana in pieces with a knife
18	Breaking a baguette by hand
19	Tearing a banana peel in two with a pair of pliers
20	Tearing a sheet of paper off a notepad by hand
21	Cutting cloth with scissors
22	Cutting bread with a single blade of scissors
23	Cutting a bunch of spring onions by moving them against a static knife
24	Cutting a twig off a tree with an axe
25	Breaking a glass by knocking it off the table with an elbow
26	Breaking a piece of a rope with chisel and hammer
27	Cutting a piece off a banana with scissors
28	Cutting a rope in two pieces with a knife

6.3.1 Use of C&B action verbs

In this section, I aim to find out how the children and the adults used action verbs to categorize the 28 C&B events: what semantic distinctions did they make and how did speakers of different ages differ?

Recall that, as reported in Chapter 4, participants of all ages typically encoded the C&B events with RVCs that indicate both the action and the result in a single compound verb. But there are some stimuli for which even the adult participants often produced a simplex C&B verb that specifies only the action.[45] For example, for the event showing a woman cutting a banana into pieces with a knife (stimulus no. 17), all the adults produced a single

[45] This may be due to the salience of the action in these video clips and a tendency not to describe a result that seems too obvious.

action verb, *qie1* 'cut with a single-bladed instrument' (i.e., they described the event as 'a woman is cutting a banana'); and for the event showing a man breaking a baguette (stimulus no. 18), six of the ten adults used a single action verb *bai1* 'bend' ('a man bent bread') and only four provided a result verb *kai1* 'open, apart', in the RVC *bai1-kai1* 'bend-be open' ('a man bent-open bread'). In my analysis I included the action verbs regardless of whether they were used alone or as the first component of an RVC.

Figure 6.1 shows, for each age group, the percentage of different action verb responses. Overall, four verbs, *qie1, jian3, si1,* and *bai1,* are the most frequent, accounting for more than 70% of the total action verbs in each age group (see Appendix 6.1 for the raw frequencies of these four main action verbs by age). The proportion of each of these four verbs is also similar across age groups; e.g., in every age group *qie1* comprises about 20% to 30% of the action verb responses. In general, then, the children used the same action verbs (in particular, the four most frequent ones) as the adults, and with comparable frequencies.

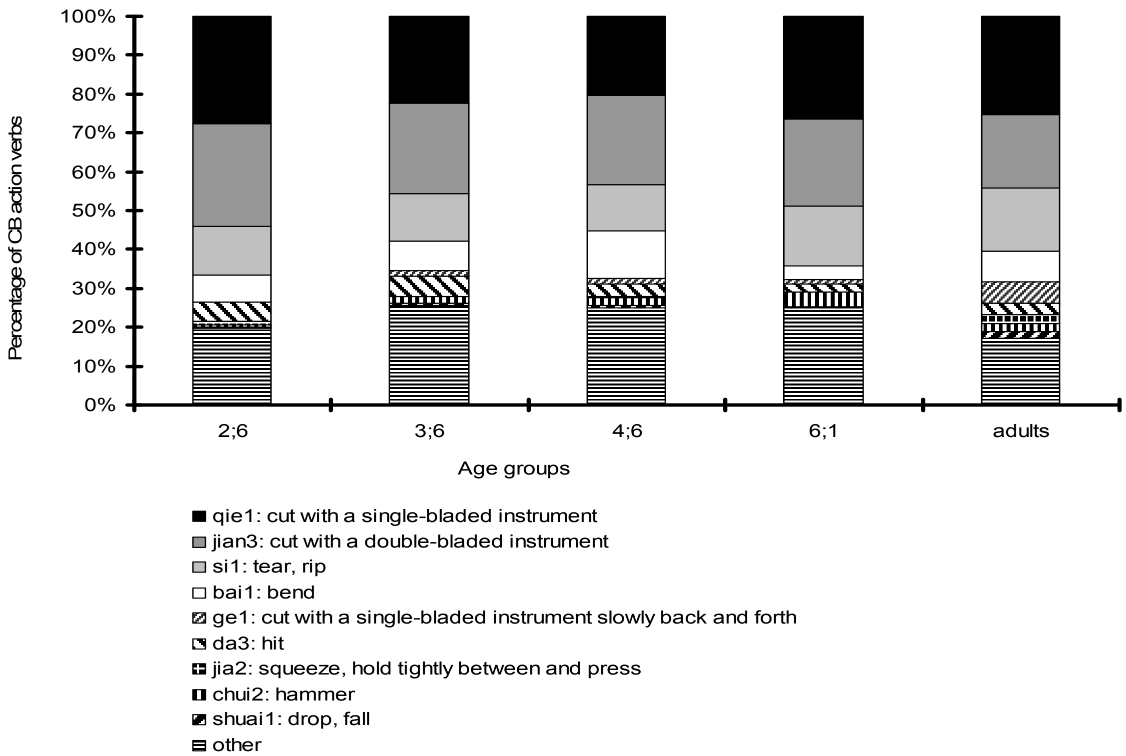


Figure 6.1. Percentages of responses accounted for by various C&B action verbs[46] by age, collapsed across stimulus events

[46]Although the three verbs *jia2* 'hold.tightly, squeeze', *da3* 'hit', *chui2* 'hammer', and *shuai1* 'drop, fall' are not in themselves C&B verbs – they can be used for many events other than C&B events – they are elicited by these stimuli because the destruction or separation of an object was often brought about by such an action.

To compare the children more closely with the adults, I determined, for each stimulus, whether at least 6 of the 10 adults (60%) had used the same action verb; if so, this was considered the "target action verb" for this stimulus, and the use of the verb was a "target use". Table 6.2 shows the stimuli and the frequencies of the target action verbs broken down by age group, as well as the stimuli on which agreement did not reach 60%.

For 21 of the 28 stimuli, the adults agreed on which of the four major C&B action verbs to use. For example, when the event involved the use of scissors or another double-bladed instrument, they used *jian3*; and when it involved a knife or other single-bladed instrument, they used *qie1*. The adults obviously treated the semantic feature "instrument" – in particular, the distinction between cutting carried out with the use of a single-bladed instrument vs. a double-bladed instrument – as a decisive factor in their categorization of the events. To make an obligatory distinction based on this feature seems to be relatively rare; it occurs in only 5 of the 28 languages studied with closely-related stimulus materials (Majid, Bowerman, van Staden, & Boster, 2007): two Germanic languages, Dutch and Swedish; a west Papuan language, Tidore, and an Otomanguean language, Otomi (spoken in central Mexico). English does not make this distinction obligatorily; the general verb *cut* applies to cutting events involving either type of instrument.

The children used the target verbs less uniformly than the adults. They resembled the adults in their use of *jian3* 'cut with a double-bladed instrument', but they initially underused *qie1* 'cut with a single-bladed instrument', *si1* 'tear, rip', and *bai1* 'bend'. The 6-year-olds used *bai1* 'bend' distinctly less often than the adults, preferring other action verbs for target *bai1* stimuli such as "break chocolate by hand" and "break baguette by hand"; these verbs include *ba2* 'pull', *fen1* 'separate, split', and *si1* 'tear, rip'. All other age groups mostly used the target verb *bai1*.

Seven events did not reach the 60% agreement criterion in the adult responses (see Table 6.2). This was because the adults tended to label these events with two or more verbs that were more or less synonymous. For example, for "snapping" events such as "breaking a twig by hand" (stimulus no. 2), the adults used both *zhe2* 'bend by hand (of thin linear objects)' and *bai1* 'bend by hand (of linear object, but not necessarily thin)'. *Zhe2* sounds more literary.

Table 6.2. Stimuli described with target C&B action verbs by age

(Criterion: Target use is at least 6 out of 10 adult responses)

No.	STIMULI		AGE				
	Target verb *jian3* 'cut with a double-bladed instrument (e.g., scissors)'		**2;6**	**3;6**	**4;6**	**6;1**	**adults**
1	Cutting a piece of paper with scissors		9	10	10	10	9
6	Cutting nails with a nail clipper		10	10	10	10	10
15	Cutting hair with scissors		10	10	9	10	10
21	Cutting cloth with scissors		10	10	10	10	10
27	Cutting a piece off a banana with scissors		9	9	9	10	10
	TOTAL		**48**	**49**	**48**	**50**	**49**
	Target verb *qie1* 'cut with a single-bladed instrument (e.g., knife)'						
8	Cutting a piece of cake with a piece of a broken pot		8	6	7	9	8
9	Cutting an egg in slices with a wire egg cutter		2	1	0	5	9
13	Cutting a piece of paper with a knife		9	9	9	10	9
17	Cutting a banana in pieces with a knife		10	9	9	9	10
3	Cutting a slice of bread with a knife		10	9	10	10	10
22	Cutting bread with a single blade of scissors		3	2	2	5	9
	TOTAL		**42**	**36**	**37**	**48**	**55**
	Target verb *si1* 'tear with hand(-like) instrument'						
5	Tearing a piece of cloth by hand		10	6	7	6	7
14	Tearing a slice of bread in two pieces by hand		3	5	5	6	7
16	Tearing open a plastic bag by hand		6	6	8	8	10
19	Tearing a banana peel in two with a pair of pliers		7	2	0	2	6
4	Tearing a piece of paper along a knife		7	4	6	8	6
20	Tearing a piece of paper off a notepad by hand		8	8	8	9	10
	TOTAL		**41**	**31**	**34**	**39**	**46**
	Target verb *bai1* 'bend'						
7	Breaking a bar of chocolate by hand		5	5	9	5	7
18	Breaking a baguette by hand		5	6	8	4	9
	TOTAL		**10**	**11**	**17**	**9**	**16**
	Target verb *chui2* 'hammer'						
10	Breaking a pot with a hammer		2	5	5	10	6
	Target verb *jia2* 'hold.tightly, squeeze'						
12	Cutting the head of a nail off with a pair of pliers		2	0	1	0	6
	Stimuli for which there was less than 60% agreement among the adults	**Sample verbs**	**2;6**	**3;6**	**4;6**	**6;1**	**Adults**
2	Breaking a twig by hand	*bai1*	4	4	6	2	3 (7 *zhe2)*
11	Cutting a twig off a tree with a knife	*qie1*	9	5	2	3	2 (8 *ge1)*
23	Cutting a bunch of spring onions by moving them against a static knife	*qie1*	1	5	2	3	5 (3 *ge1)*
24	Cutting a twig off a tree with an axe	*qie1*	6	2	6	9	1
25	Breaking a glass by knocking it off the table with an elbow	*jian3*	1	0	0	0	0
26	Severing a piece of a rope with chisel and hammer	*qie1*	6	3	0	0	2
28	Cutting a rope in two pieces with a knife	*qie1*	4	6	9	10	4 (4 *ge1*)

zhe2: bend by hand (of thin linear object)

ge1: cut slowly, back and forth

Note: The English glosses of these verbs are approximate, since, unlike English verbs, none of the Mandarin verbs entails a state change.

When the children did not use the target verb for a stimulus, what verbs did they use instead? Recall that four verbs, *qie1, jian3, bai1* and *si1,* were used most frequently by both adults and children. Table 6.3 is a set of confusion matrices that show which of these verbs were substituted for target verbs. The first column indicates the target verbs, and the other columns show the frequencies of the verbs that children used instead. The numbers in bold indicate the most frequent substitutions.

Table 6.3. Confusion matrices of children's substitutions for target uses of the four most frequent C&B action verbs, by age

TARGET VERBS	SUBSTITUTIONS FOR TARGET VERBS			
2;6-year-olds	*jian3*	*qie1*	*si1*	*bai1*
jian3	-	2	*0*	*0*
qie1	**6**	-	*0*	1
si1	**8**	5	-	4
bai1	*0*	*0*	*0*	-
3;6-year-olds	*jian3*	*qie1*	*si1*	*bai1*
jian3	-	1	*0*	*0*
qie1	**4**	-	1	2
si1	**6**	1	-	3
bai1	*0*	*0*	1	-
4;6-year-olds	*jian3*	*qie1*	*si1*	*bai1*
jian3	-	*0*	*0*	*0*
qie1	**6**	-	*0*	1
si1	**4**	2	-	**9**
bai1	*0*	*0*	*0*	-
6;1-year-olds	*jian3*	*qie1*	*si1*	*bai1*
jian3	-	*0*	*0*	*0*
qie1	2	-	*0*	1
si1	**5**	1	-	2
bai1	*0*	*0*	3	-

Across all age groups, the children tended to substitute *jian3* 'cut with a double-bladed instrument' for both *qie1* 'cut with a single-bladed instrument' and *si1* 'tear, rip'. Most of these errors occurred on only two stimuli: no. 19 ("tearing a banana peel in two with a pair of pliers"), for which the adults uniformly used *si1* 'tear, rip', and no. 22 ("cutting bread with a single blade of scissors"), for which the adults uniformly used *qie1* 'cut with a single-bladed instrument'. These errors suggest that the children had learned that "instrument" is an important feature governing the use of a C&B action verb (single-bladed vs. double-bladed tool), but had not yet learned that attention must also be given to the part of the instrument used and to the manner in which the action is carried out (e.g., *jian3* is not appropriate for cutting done with a single blade even if the tool is a pair of scissors, or for tearing a banana peel by clamping it fast with the “double blades” of a pair of pliers and pulling on it). Even at the age of 6;1, Mandarin children still did not display adult-level usage.

So far I have shown how the children and adults used C&B action verbs (including both simplex verbs and the V_1s in an RVC). Let us now turn to the result verbs.

6.3.2 Use of C&B result verbs

All the result verbs produced by each participant were counted. Overall, the adults produced more result verbs than the children, but not by very much (token frequency 168 [adults] vs. 157 [averaged across child age groups]). Even the 2;6-year-olds produced many result verbs (token frequency 124). A total of eight different result verbs was identified across all the groups: *kai1* ‘be open, apart’, *duan4* ‘be broken crosswise (of linear object)’, *lan4* ‘be smashed, in pieces, tattered, rotten’, *sui4* ‘be smashed, in pieces’, *xia4-lai2* ‘descend-come (come off)’, *huai4* ‘be broken’, *diao4* ‘fall, be off’, and *xia4* ‘descend, be off’.

Figure 6.2 shows, for each age group, the percentage of all the result verb responses accounted for by these eight verbs. The token frequencies with which the five most frequent verbs (*kai1* ‘be open, apart’, *duan4* ‘be broken crosswise [of linear object]’, *lan4* ‘be smashed, in pieces, tattered, rotten’, *sui4* ‘be smashed, in pieces’ and *xia4-lai2* ‘descend-come [come off]’) were applied to each stimulus are given in Appendix 6.2. Three result verbs – *kai1* ‘be open, apart’, *duan4* ‘be broken crosswise (of linear object)’, and *lan4* ‘be smashed, in pieces, tattered, rotten’ – were the most frequent, accounting for nearly 75% of all the result verbs in each age group. But the distribution of these verbs differed across ages.

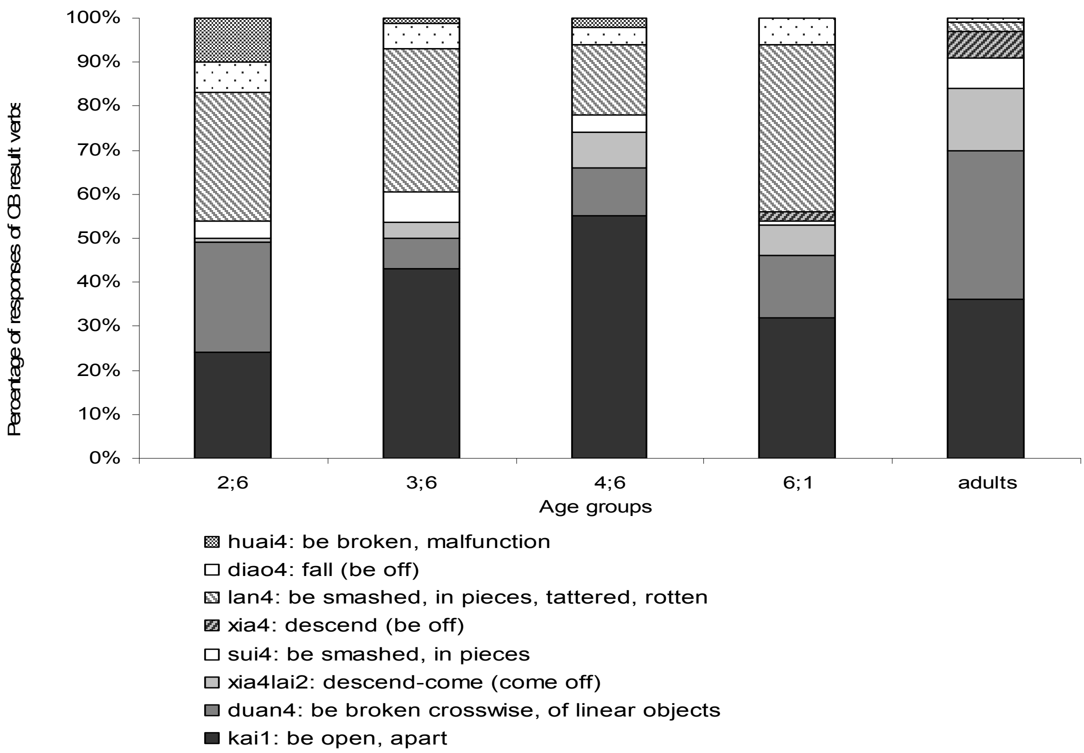


Figure 6.2. Percentages of the C&B result verbs across all stimulus events by age

In order to compare the children more closely with the adults, I determined, for each stimulus, whether at least 3 of the 10 adults (30%) had used the same result verb; if so, this was considered a "target result verb" for this stimulus, and the use of the verb was a "target use". This is similar to what I did for the action verbs, but there the "target" criterion was 6 out of 10 adults. For the result verbs, a lower target criterion was necessary because the participants did not provide a result verb for every stimulus and there is more variation in the result verbs than was true for the action verbs (this will be discussed in following section). Table 6.4 shows the stimuli and the frequencies of the various target result verbs broken down by age, as well as the stimuli on which agreement did not reach 30%. Two stimuli, no. 15 ("cutting hair with scissors") and no. 17 ("cutting a banana in pieces with a knife"), are not shown in Table 6.4 because no result verbs were used by either the adults or the children.

The four result verbs used most consistently by the adults were *duan4* 'be broken crosswise (of linear object)', *kai1* 'be open, apart', *xia4-lai2* 'descend-come (come off)', and *sui4* 'be smashed, in pieces', e.g., there was an average of 63% agreement for *duan4* and 43% for *kai1*. The children, in contrast, rarely showed 30% agreement or above, even the 6;1-year-olds. Interestingly, though, they used *lan4* more frequently and consistently than the adults (to be discussed in §6.3.3).

Table 6.4. Stimuli described with target C&B result verbs, by age

(Criterion: Target uses is at least 3 out of 10 adult responses)

No.	STIMULI		AGE				
	Target verb *duan4* 'be broken crosswise (of linear object)'		**2;6**	**3;6**	**4;6**	**6;1**	**Adults**
2	Breaking a twig by hand		5	0	4	5	9
12	Cutting the head of a nail off with a pair of pliers		1	0	0	1	8
28	Cutting a rope in two pieces with a knife		4	2	1	1	7
11	Cutting a twig off a tree with a knife		2	1	2	0	6
26	Breaking a piece of a rope with chisel and hammer		4	0	2	4	6
24	Cutting a twig off a tree with an axe		2	3	1	2	5
27	Cutting a piece off a banana with scissors		0	0	0	0	5
23	Cutting a bunch of spring onions by moving them against a static knife		2	0	4	3	4
	TOTAL		**20**	**6**	**14**	**16**	**50**
	Target verb *kai1* 'be open, apart'						
16	Tearing a plastic bag by hand		2	0	5	1	6
22	Cutting bread with scissors		0	0	4	2	6
18	Breaking a baguette by hand		2	4	6	3	5
19	Tearing a banana peel in two with a pair of pliers		1	1	3	2	5
4	Tearing a piece of paper along a knife		1	0	4	3	4
14	Tearing a slice of bread in two pieces by hand		2	2	5	2	4
21	Cutting cloth with single blade of scissors		0	0	0	0	4
8	Cutting a piece of cake with a piece of a broken pot		1	2	3	1	3
9	Cutting an egg in slices with a wire egg cutter		2	1	0	1	3
13	Cutting cardboard with a knife		0	0	1	1	3
	TOTAL		**11**	**10**	**31**	**16**	**43**
	Target verb *xia4-lai2* 'descend-come (= be off)'						
1	Cutting paper with scissors		0	0	0	2	6
2	Breaking a twig by hand		0	0	1	0	3
3	Cutting a slice of bread with a knife		0	1	0	1	3
4	Tearing a piece of paper along a knife		0	0	2	1	3
5	Tearing a piece of cloth by hand		0	0	0	0	3
	TOTAL		**0**	**1**	**3**	**4**	**18**
	Target verb *sui4* 'be smashed, in pieces'						
25	Breaking a glass by knocking it off the table with an elbow		1	3	2	2	7
	Stimuli for which there was less than 30% agreement among the adults	**Sample verbs**	**2;6**	**3;6**	**4;6**	**6;1**	**Adults**
6	Cutting nails with a nail clipper	*xia4-lai2*	0	0	0	0	2
7	Breaking a bar of chocolate by hand	*xia4-lai2*	0	0	1	1	2
10	Breaking a pot with a hammer	*lan4*	6	3	5	10	2
25	Breaking a glass by knocking it off the table with an elbow	*lan4*	7	7	4	6	1

lan4 'be smashed, in pieces, tattered, rotten'

When the children did not use the target verbs for a stimulus, what verbs did they use instead? Recall that the adults used four result verbs, *duan4, kai1*, *xia4-lai2*, and *sui4*, more consistently than the other verbs, so I examined which verbs were substituted for target uses of these verbs. The result is summarized in the confusion matrices shown in Table 6.5. The first column indicates the target verbs, and the other columns show, for each age group separately, the frequencies of the verbs used instead. The numbers in bold indicate the most frequent substitutions.

Table 6.5. Confusion matrices of children's substitutions for target uses of the four most frequent C&B result verbs, by age

TARGET VERBS	SUBSTITUTIONS FOR TARGET VERBS						
2;6-year-olds	*duan4*	*kai1*	*xia4-lai2*	*sui4*	*lan4*	*diao4*	*huai4*
duan4	-	**3**	0	0	**5**	2	**4**
kai1	1	-	0	0	**3**	0	1
xia4-lai2	2	0	-	0	0	1	0
sui4	0	0	0	-	**7**	0	1
3;6-year-olds	*duan4*	*kai1*	*xia4-lai2*	*sui4*	*lan4*	*diao4*	*huai4*
duan4	-	**6**	0	1	**7**	1	0
kai1	0	-	0	0	**4**	0	0
xia4-lai2	0	1	-	0	0	0	1
sui4	0	0	0	-	**7**	0	0
4;6-year-olds	*duan4*	*kai1*	*xia4-lai2*	*sui4*	*lan4*	*diao4*	*huai4*
duan4	-	**13**	**6**	0	**8**	2	0
kai1	0	-	2	0	1	0	0
xia4-lai2	0	0	-	0	0	1	0
sui4	0	0	0	-	**4**	0	0
6;1-year-olds	*duan4*	*kai1*	*xia4-lai2*	*sui4*	*Lan4*	*diao4*	*huai4*
duan4	-	**5**	**12**	0	0	0	0
kai1	0	-	0	0	1	1	0
xia4-lai2	0	**4**	-	0	1	0	0
sui4	0	0	2	-	**6**	0	0

The most frequent substitutions involve the use of *lan4* 'be smashed, in pieces, tattered, rotten' in place of a target verb (see the sixth column, headed by *lan4*). *Lan4* describes the state of being broken into pieces, and it emphasizes the loss of integrity of the affected object and the functional destruction – that the broken object can no longer function as it is intended to (e.g., a broken cup can no longer hold water).[47] In comparison to adults, the children preferred *lan4* to describe events in which an object ended up in pieces or being apart, especially where adults said *duan4* 'be broken crosswise (of linear object), *kai1* 'be open, apart', or *sui4* 'be smashed, in pieces' (this last verb emphasizes the physical state of being broken into tiny pieces). Children seem to attend to and emphasize the loss of function of an object when it is broken. But in many cases the use of *lan4* is inappropriate – e.g., it cannot be used to describe events in which a linear object ends up in two pieces; *duan4* 'be broken crosswise (of linear object)' is needed instead. The children do not seem to have

[47] This judgment is based on my own native speaker's intuition and that of three other adult native speakers of Mandarin.

learned the subtle semantics of *lan4* yet, even beyond age 6. For example, a girl of 6;4 consistently overextended *lan4* to most of the events where *kai1* or *duan4* should have been used.

The children also tended to substitute *kai1* 'be open, apart' for target uses of *duan4* 'be broken crosswise, (of linear object)'. These substitutions in many cases are inappropriate. The extensional category associated with *duan4* is more constrained than that of *kai1: duan4* only describes C&B events in which the affected objects are linear and separated crosswise, whereas *kai1* can be applied to all C&B events in which an object ends up broken or apart.[48] The overuse of *kai1* suggests that children have not fully learned the semantics of *duan4*, and they tend to use a more general verb that applies to a wider range of events before they figure out the specific semantic features that matter in encoding a C&B result.

The oldest two groups of children, the 4;6- and 6;1-year-olds, also substituted *xia4-lai2* 'descend-come' (come off) for *duan4* (see the fourth column). These substitutions occurred in the descriptions of only two stimuli, no. 24 "cutting a twig off a tree with an axe" and no. 12 "cutting the head of a nail off with a pair of pliers", which both involve severing a long object. *Duan4* 'be broken crosswise, (of linear object)' is the target use in the adult descriptions. But adults can also use *xia4-lai2* to describe these two events, since they involve detaching part of an object. The use of *xia2-lai2* emphasizes the direction of motion, i.e., that the severed part moves away from its base as a result of cutting, whereas the use of *duan4* emphasizes the result of being severed. It seems that the 4;6- and the 6;1-year-olds somehow took a different perspective on these events than the adults.

6.3.3 Semantics of C&B verbs and the categorization of events they impose

So far my analyses of the C&B action verbs and result verbs are piecemeal and rather general, emphasizing, e.g., the overall number of verbs used by different age groups, the verbs used for certain stimuli by age, and the verbs that often substitute for each other. The interpretation of the semantic features associated with the verbs is also quite general. To arrive at a more coherent picture of how speakers of different ages classify the stimulus events by their use of verbs, and how their verbs are related to each other by virtue of this use, we need a method that takes more of the data into account at once in a single analysis. The method I have chosen is correspondence analysis, a technique that can capture the complex relationships

---

[48] *Kai1* also describes events in which an object is made accessible by removing the cover, such as opening a box. But this meaning is not tested in the current set of stimuli.

among the stimulus events, the verbs, and the age groups, and allow us to visualize these relationships in multi-dimensional plots (see Greenacre, 1984, on the method, and Majid et al., 2004; Majid et al., 2007, for its application to "cutting and breaking" data collected with an elicitation method similar to the one I have used).

My correspondence analyses plot verbs, stimuli, and age groups into a common space (termed a *joint plot*) that reflects how similarly any two stimuli were described and how similarly any two verbs were used, broken down by age groups. The similarity of stimuli is assessed by determining how similarly consultants label them. For example, two stimuli that are both unanimously described with the same verb(s) will be treated as completely similar (plotted on top of each other in the space). Conversely, two stimuli that no consultant describes with the same verb are completely dissimilar (plotted maximally far apart). And two stimuli that are labeled with the same verb by some speakers but not by others are intermediate in similarity. The distribution of verbs across stimuli can be used to assess not only how similar the stimuli are to each other but also how similar the verbs are to each other: verbs are similar to the extent that they are applied to the same stimuli. The similarity of the stimuli to each other and of the verbs to each other is represented in terms of physical closeness in a multidimensional space: the more similar two stimuli or two verbs are, the closer together they are plotted in the space. The relative importance of the dimensions that structure the multidimensional space is reflected in the order in which the dimensions are extracted: the first dimension captures the most variance among the stimulus events and the verbs, the second dimension the next most, and so on.

In what follows, I carried out two correspondence analyses. The first is based on the C&B action verbs and the second on the result verbs.

6.3.3.1 Similarity structure – C&B action verbs

In the first correspondence analysis, I included only the four most frequent action verbs (*jian3* 'cut with a double-bladed instrument', *qie1* 'cut with a single-bladed instrument', *si1* 'tear, rip', and *bai1* 'bend'). Taken together, these account for about 70% of the responses (see Figure 6.1). As the first step in the analysis, I created a data matrix with 28 rows (the stimuli), and 20 columns (4 × 5: the 4 verbs times the 5 age groups). In a cell representing the intersection of a particular stimulus, a particular age group, and a particular verb is a number that indicates how many of the ten participants used the verb. This matrix was submitted to correspondence analysis in SPSS. Since 94.2% of the inertia (a measure in a correspondence analysis that is similar to variance) was explained by the first three dimensions, I limit my presentation to these three.

The data are represented in two plots: dimension 1 plotted against dimension 2 (Figure 6.3), and dimension 2 plotted against dimension 3 (Figure 6.4). These plots show (1) the similarities among the 28 stimuli (represented by tiny pink squares, labeled with their item numbers in black), and (2) the similarities among the four verbs, broken down by age group (the verbs are represented by tiny green squares, labeled by the verb shown in capital letters, followed by a number or letter specifying the age group, e.g., JIAN_2 (the verb *jian3* as used by the 2;6-year-olds), JIAN_A (the verb *jian3* as used by the adults). The similarities between the stimuli, as well as between the different verbs and the same verbs as used by different age groups, are reflected in their positioning in the plot.

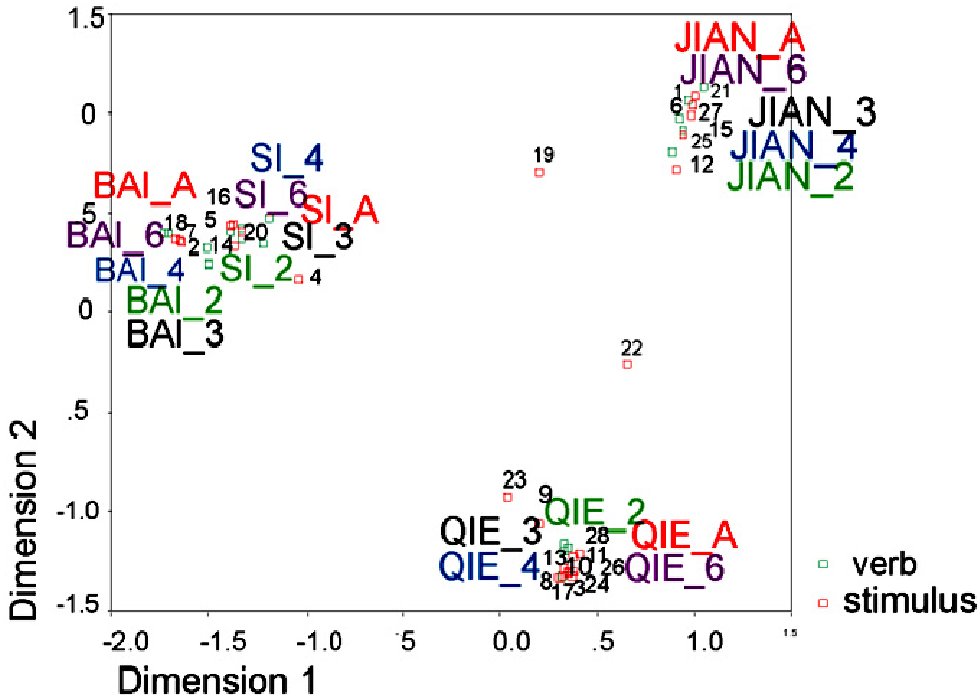


Figure 6.3. Correspondence analysis plot of stimuli and C&B action verbs along dimensions 1 and 2

jian3 'cut with a double-bladed instrument'
qie1 'cut with a single-bladed instrument'
si1 'tear, rip'
bai1 'bend'

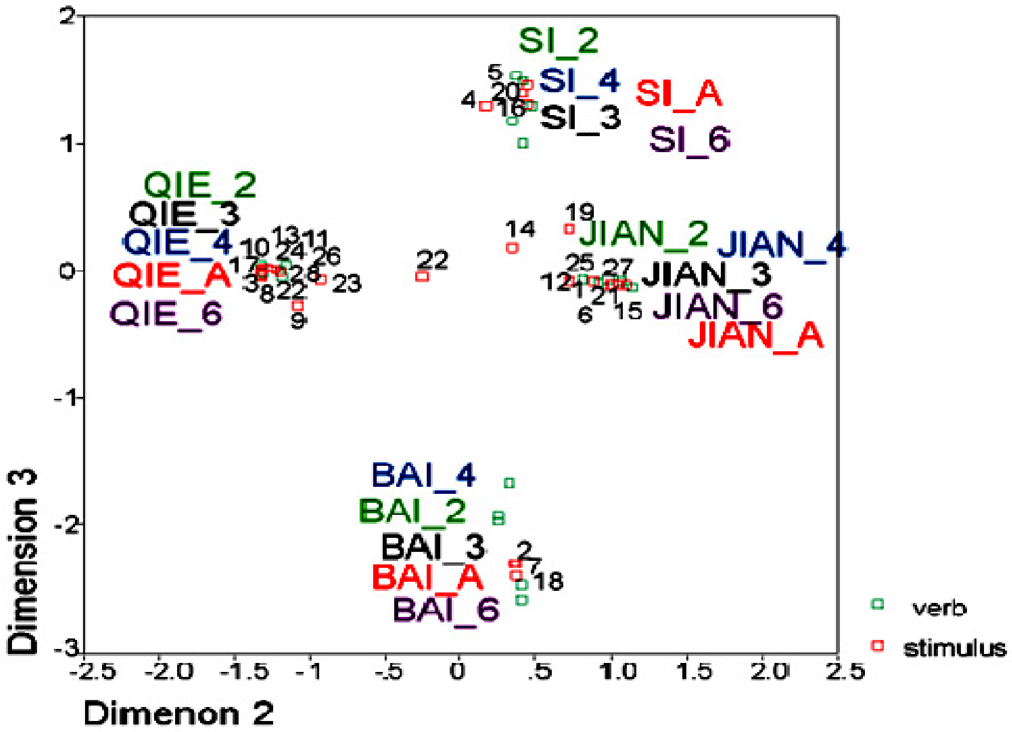


Figure 6.4. Correspondence analysis plot of stimuli and C&B action verbs along dimensions 2 and 3

The first dimension in Figure 6.3 (on the horizontal axis) clearly distinguishes events of cutting with a double-bladed instrument (expressed with *jian3*) from events of breaking by hand, i.e., tearing (i.e., *si1* 'tear, rip' used for events such as tearing a plastic bag) and snapping (*bai1* 'bend' used for events such as breaking a twig by hand).[49] Events of cutting with a single-bladed instrument occupy an intermediate position along this dimension. So instrument is a salient feature to which Mandarin speakers consistently attend. Stimuli 1, 6, 12, 15, 21, and 27,[50] which cluster together in the plot, all involve the instrument scissors. Notice that the points representing these stimuli are also situated close to the various age-group versions of the verb *jian3* 'cut with a double-bladed instrument', which suggests that 'double-bladed instrument' is an important semantic feature for the verb *jian3* for Mandarin speakers of all ages.

The second dimension in Figure 6.3 (vertical axis; also seen on the horizontal axis in Figure 6.4) distinguishes events of cutting with a double-bladed instrument from events of

[49] We can see this by inspecting the distance of the clusters of verbs or stimuli to the zero point on the dimension. If they are far from the zero point in opposite directions, the clusters are very distinct from each other; if they are close to the zero point, they are not distinguished from each other by that dimension.

[50] Stimulus 25 (breaking a glass by knocking it off the table with an elbow) also appears in the *jian3* cluster in Figure 6.3, even though it does not involve a double-bladed instrument. This is probably due to the overextension of *jian3* to this stimulus by two three-year-olds.

cutting with a single-bladed instrument. These latter include stimuli 3, 8, 9, 11, 13, 17, 23, 24, 26, and 28, all of which are situated in the plot close to the verb *qie1* 'cut with a single-bladed instrument' (e.g., knife; potsherd).

The third dimension in this analysis (vertical axis of Figure 6.4) subdivides the events of breaking by hand (the leftmost cluster on dimension 1 in Figure 6.3) into "tearing" events (stimuli 4, 5, 16, and 20) and "snapping" events (stimuli 2, 7, 18). Tearing and snapping both involve breaking an object by hand, but the affected objects differ in their physical properties: *bai1* 'bend' was used only for rigid linear objects (e.g., stick), while *si1* 'tear, rip' was used for flexible 2-dimensional objects (e.g., paper, cloth). So properties of the affected object are also important in the choice of a C&B action verb.

The clear clusters of stimuli and their associated verbs indicate that the participants consistently used the same verbs for the same distinct sets of stimulus events, and that there was relatively little overlap of verbs. Interestingly, stimulus 19 (tearing a banana peel in two with a pair of pliers) and stimulus 22 (cutting bread with a single blade of a pair of scissors) do not fall into any of the clusters. Stimulus 19 lies between the *jian3* cluster and the *si1/bai1* cluster along dimension 1 (Figure 6.3), which is because some of the participants described this novel event with *jian3* 'cut with a double-bladed instrument' and others with *si1* 'tear, rip' or *bai1* 'bend'. The use of pliers on the banana peel suggests *jian3,* since the separation is effected by squeezing the peel between the two "blades", but the fact that the peel is torn rather than "cut" suggests *si1* 'tear, rip'. The adults mostly used *si1* for this event (6 out of 10, cf. Table 6.2) and none of them used *jian3* (the four other adults used *che3* 'pull' or *jia2* 'hold.tightly, squeeze'). Stimulus 22 lies between the *jian3* and the *qie1* clusters along dimension 2. This shows that both *jian3* 'cut with a double-bladed instrument' and *qie1* 'cut with a single-bladed instrument' were used for this odd event. Most of the adults said *qie1* (9 out of 10, cf. Table 6.2), since the cutting involved a single blade even though the tool was a pair of scissors, but the children often said *jian3*. The novelty of these two stimuli probably contributed to children's errors. These stimuli had in fact been explicitly designed to "trick" children into revealing whether they were attending to the identity of an instrument as a whole, regardless of how it is used, or were sensitive to the details of its use.

Besides showing the relationship between the stimuli and the verbs, Figures 6.3 and 6.4 reveal the extent to which the different age groups described the stimuli in the same way. Note in particular that for each of the four action verbs, all the age groups are situated close to each other in the same cluster. Even the youngest children resemble the older children and the adults in their use of the verbs. This suggests that from as young as 2;6 years, learners of Mandarin tune in to the semantic features that Mandarin lexicalizes in encoding such events. In particular, they weight the semantic feature "instrument" as much as adults do: they attend to whether the action is done by hand or by a bladed instrument (distinguished along dimension 1), and also to whether the instrument is single- or double-bladed (picked out by dimension 2). This latter is a rather specific distinction made in only some languages, including Dutch, Swedish, and Mandarin (Majid et al., 2007).

To summarize, this correspondence analysis shows that Mandarin speakers typically categorize the C&B actions according to the instrument and the properties of the affected object. A particular distinction is made between single-bladed and double-bladed instruments. The children are remarkably similar to the adults in their choice of action verb to describe the stimulus events, and so also in their overall semantic categorization of the events.

6.3.3.2 Similarity structure – C&B result verbs

Just as for the C&B action verbs, I applied correspondence analysis to the C&B result verbs as well. This analysis was also aimed at extracting the most important dimensions organizing the similarity space of our stimuli, in this case according to speakers' choice of result verbs, and at determining how similarly these verbs were used by different age groups. Similarity relationships are again represented by plotting both the stimuli and the verbs, broken down by age groups, in a single multidimensional space.

For this analysis I took into account the three most frequent result verbs, *kai1* 'be open, apart', *duan4* 'be broken crosswise (of linear object)', and *lan4* 'be smashed, in pieces, tattered, rotten', since these verbs account for 70-85% of all the result verb tokens (see Figure 6.2). As in analyzing the action verbs, I first created a data matrix with 28 rows (the stimuli), and, in this case, 15 columns (3 × 5, the 3 verbs times the 5 subject groups). The cells of the matrix indicate how many participants in a particular age group used a particular verb for a particular stimulus. This matrix was submitted to correspondence analysis in SPSS. Since 80.2% of the inertia was explained by the first three dimensions, I limit my presentation to these dimensions.

Two joint multidimensional semantic plots were generated: dimension 1 plotted against dimension 2 (Figure 6.5), and dimension 2 plotted against dimension 3 (Figure 6.6). As in my analysis of the action verbs, these plots show (1) the similarities among the 28 stimuli (represented in the plot by tiny red squares and their identifying numbers), and (2) the similarities among the three result verbs, broken down by age group (represented by tiny green squares, labeled by the verb shown in capital letters, followed by a number or letter specifying the age group – e.g., KAI_4, *kai1* ‘be open, apart’ as used by the 4;6-year-olds, KAI_A, *kai1* ‘be open, apart’ as used by the adults). Recall that the positioning of stimuli and verbs in such a plot represents how similarly these items were treated. The closer any two stimuli, the more similarly subjects described them, and the closer any two verbs (or instances of the same verb as used by different age groups), the more often they were used to describe the same stimuli.

Let us first examine the plotting of the stimuli by the C&B result verbs on the first two dimensions (see Figure 6.5). Unlike the stimuli as plotted on the basis of the action verbs, which formed tight event clusters (see Figures 6.3, 6.4), the stimuli now seem to sprawl across the plot. Still, the stimuli labeled with *duan4, kai1*, and *lan4* cluster loosely. Stimuli labeled with *duan4* ‘be broken crosswise (of linear object)’ include 2, 11, 12, 23, 24, 26, 27, and 28. These all involve the crosswise separation of a long object, e.g., a twig, nail, banana, spring onion, or rope. Stimuli fairly consistently labeled with *kai1* ‘be open, apart’ include 1, 3, 7, 8, 14, 18, 19, 20, and 22. These events all involve a result state of becoming separated or apart, e.g., a bar of chocolate broken in half, a piece of cloth cut into two parts. Some stimuli fall into the space between *kai1, duan4*, and *lan4*; these include 4 (tearing a piece of paper along a knife), 5 (tearing a piece of cloth by hand), 9 (cutting an egg in slices with a wire egg cutter), 13 (cutting cardboard with a knife), 16 (tearing open a plastic bag by hand), 17 (cutting a banana in pieces with a knife), and 21 (cutting cloth with scissors). This shows that these stimuli were not consistently labeled with just one of the result verbs, but were described with two or even all three verbs.

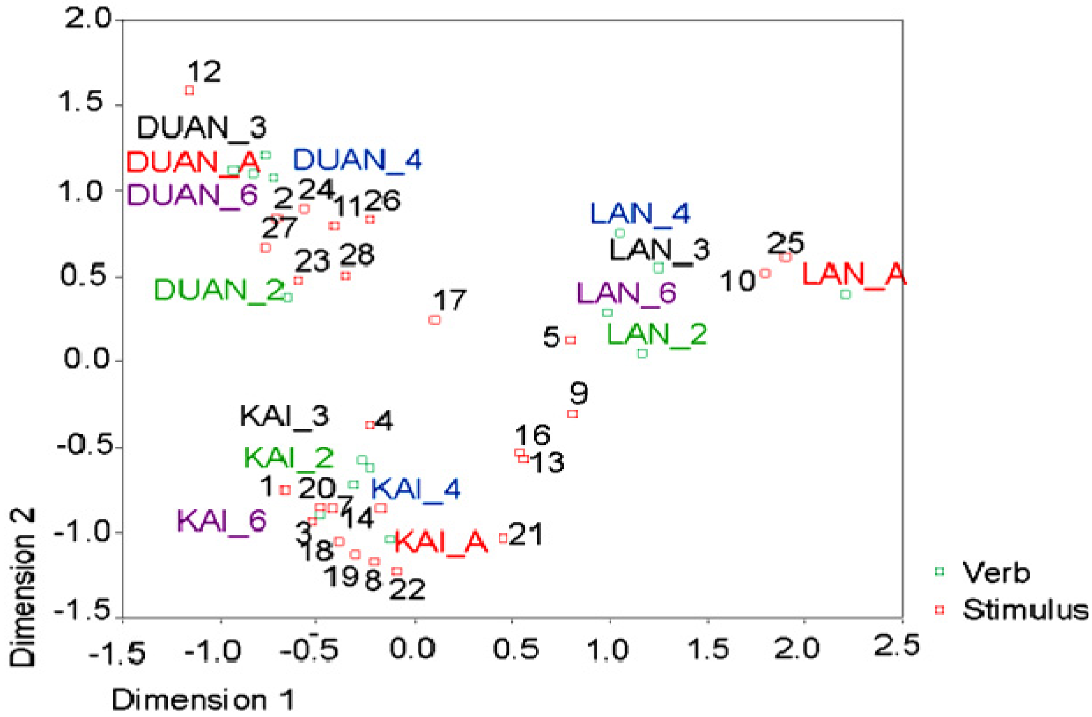


Figure 6.5. Correspondence analysis plot of stimuli and C&B result verbs along dimensions 1 and 2

duan4	'be broken, crosswise, of linear object'
kai1	'be open, apart'
lan4	'be smashed, in pieces, tattered, rotten'

The first dimension in Figure 6.5 (horizontal axis) distinguishes the *lan4* events from the *kai1* and *duan4* events. For adults, the result verb *lan4* 'be smashed, in pieces, tattered, rotten' emphasizes the functional destruction of the object. LAN_A (the adult use of *lan4*) is positioned close only to stimulus 10 (breaking a pot with a hammer) and stimulus 25 (breaking a glass by knocking it off the table with an elbow), which means that the adults produced *lan4* consistently only for these two events. The children's uses of *lan4* are positioned more toward the center of the plot. This is because they used *lan4* not only for stimuli 10 and 25, but also for 5 (tearing a piece of cloth by hand) and 9 (cutting an egg in slices with a wire egg cutter). The children's uses of *lan4* are also positioned closer to each other than to the adult use of the verb. This shows that the children are more similar to each other in their use of this verb than they are to the adults, which is consistent with the finding (see §6.2.2) that the children in all the age groups used *lan4* more than the adults.

The second dimension in Figure 6.5 (vertical axis; also seen on the horizontal axis in Figure 6.6) distinguishes the *duan4* events from the *kai1* events. As discussed in §6.2.2, *duan4* applies only to result states involving the crosswise severing of a linear object, whereas *kai1* applies to any result state of being apart or open. The children's uses of *kai1* and *duan4* are generally fairly similar to the adult uses (as shown by the proximity of KAI_2, KAI_3, etc. to KAI_A, and of DUAN2_2, DUAN_3, etc. to DUAN_A), but not identical. For example, although DUAN_2 (*duan4* as used by the 2;6-year-olds) is clearly in the *duan4* cluster, it is positioned rather far from the other groups in the direction of the *kai1* cluster. This indicates that the 2;6-year-olds often applied *kai1* to events for which the older children and the adults used *duan4.* This finding is consistent with the discussion in §6.3.2, according to which the children in general used *duan4* less frequently than the adults (cf. Table 6.4), tending to replace it with *kai1* or *lan4* (Table 6.5).

The third dimension in Figure 6.6 (vertical axis) makes a further distinction among the different age groups in the use of *duan4* 'be broken crosswise (of linear object)': the 3;6- and 4;6-year-olds are similar to each other, but differ from the 6;1-year-olds and the adults. The youngest child group, the 2;6-year-olds, falls in between on dimension 3.

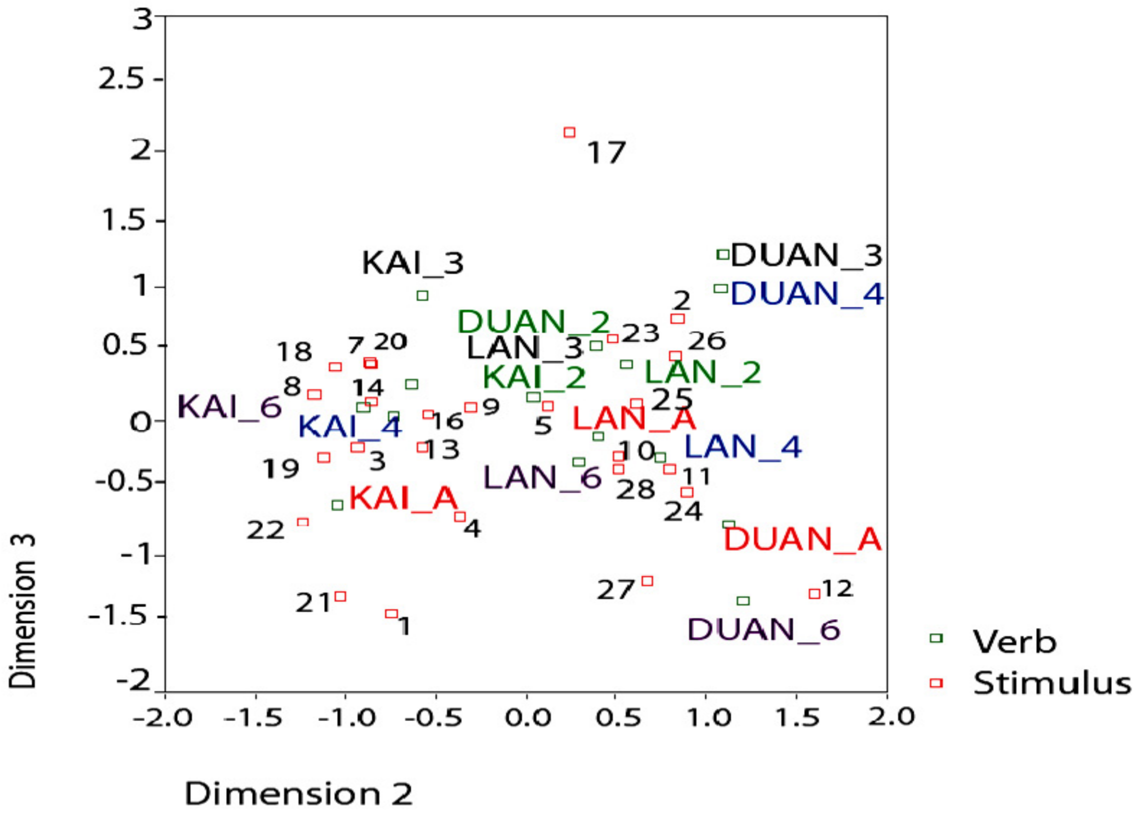


Figure 6.6. Correspondence analysis plot of stimuli and C&B result verbs along dimensions 2 and 3

duan4	'be broken, crosswise, of linear object'
kai1	'be open, apart'
lan4	'be smashed, in pieces, tattered, rotten'

The correspondence analysis of the result verbs reveals the features of the C&B events the adults typically attended to in selecting a result verb. They clearly paid attention to the physical properties of the affected object. For example, when this object was saliently linear, like a twig, nail, or rope, they used *duan4* 'be broken crosswise (of linear object)', whereas when it was two-dimensional or rounded, like a plastic bag or a stubby baguette,[51] they preferred the more general verb *kai1* 'be open, apart', which is not constrained to crosswise separations. When the object ended up in tiny pieces, they used *sui4* 'be smashed, in pieces' or *lan4* 'be smashed, in pieces, tattered, rotten'. Children's use of the result verbs approximates that of adults, but is not yet fully adult-like.

6.3.3.3 Event boundaries across age groups

In the last two sections I presented correspondence analyses of the most frequent action and result verbs (in short, the core C&B verbs) separately. The analyses generated plots that show the similarity relations between the stimuli, the age groups, and the words based only on the action verb responses (§6.3.3.1) or only on the result verb responses (§6.3.3.2). But for any particular stimulus event, the participants often encoded *both* the action subevent *and* the result subevent; for example, for "breaking a twig by hand" they typically said *bai1* 'bend' for the action and *duan4* 'be broken crosswise (of linear object)' for the result. This means that two stimuli that often share an action verb, and so fall close together in Figure 6.3, might not share a result verb, and so fall far apart in Figure 6.5. To understand the *overall* similarity relations among the stimuli, we need a more general plot in which *both* action verbs *and* result verbs contribute to the positioning of the stimulus events. Holding this plot constant as a sort of event map or etic grid, we can then draw approximate boundaries for the event categories picked out by the various action and result verbs as they are used by different age groups.[52] This will help us to visualize the patterns I have discussed in the previous two sections.

Event map determined by both the action verbs and the result verbs

To generate a general event map, I applied correspondence analysis in a somewhat different way. This time, I included 90% of all the action verbs and result verbs; these are the verbs shown in Figures 6.1 and 6.2. As in analyzing the action verbs and result verbs separately, I created a data matrix with 28 rows (the stimuli) and, in this case, 85 columns (17× 5: 17 verbs

---

[51] The baguette shown in the stimulus 18 "breaking a baguette by hand" is very short and rounded, and not the typical long one.

[52] For a precedent for this analysis, see Bowerman (1996b), who used a similar technique to compare the categories picked out by the distribution of spatial words such as *in* and *on* in child and adult speech.

[i.e., 9 action verbs plus 8 result verbs] times the 5 subject groups). The cells of the matrix indicate how many participants in a particular age group used a particular verb for a particular stimulus. This matrix was submitted to correspondence analysis in SPSS. For current purposes (i.e., to represent the overall similarities among the stimulus events), I selected the algorithm in correspondence analysis that plots only the stimuli.[53]

The plot that positions the stimuli on the basis of their values on the first two dimensions is selected as the basis for the general event map. (Recall that dimensions are extracted in order of the amount of variance in the data they account for, so the first two capture the most important similarities and differences among the stimuli.) This plot shows the global similarity of every stimulus to every other stimulus as determined by all the verbs applied to it. To help the reader visualize the stimulus events, I have replaced the tiny squares representing them in the plot with still frames extracted from the video clips (see Figure 6.7); the number in each still picture identifies the stimulus number (see Table 6.1). The distance between the still frames reflects the similarity of the stimuli only roughly; this is because I have pulled apart stimuli that fell so closely together in the plot that their pictures overlapped each other.

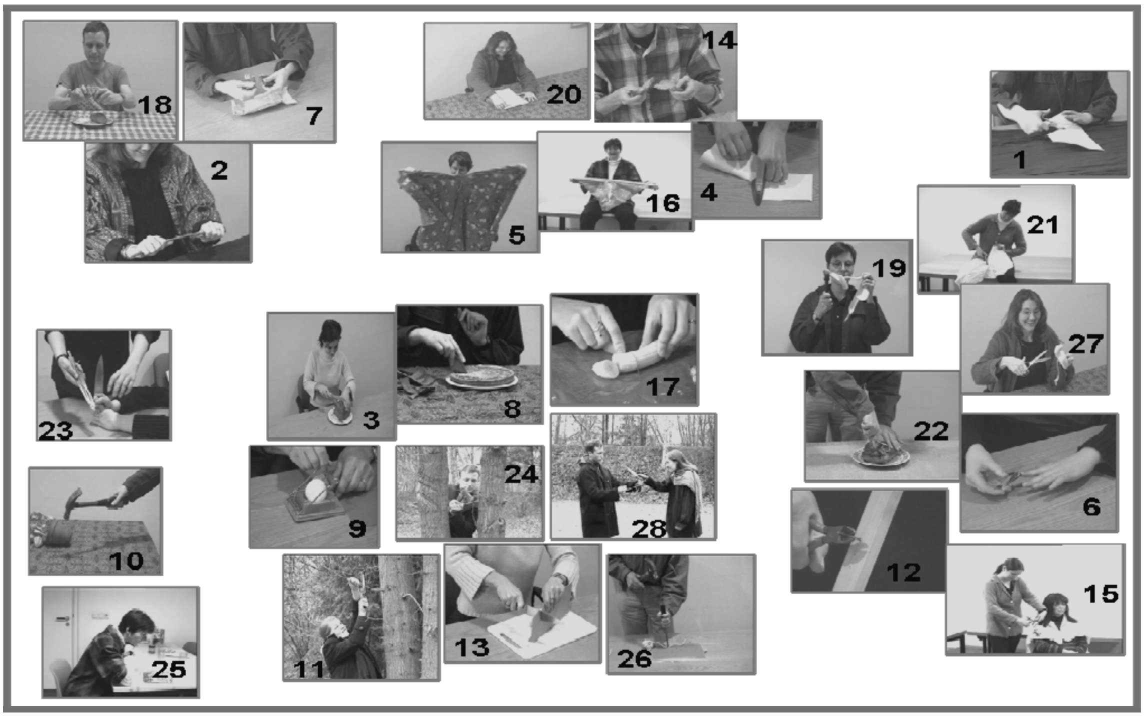


Figure 6.7. Similarity plot of the C&B events, based on high frequency verbs (both action and result) collapsed across participants

[53] Correspondence analysis in SPSS gives the user a choice among algorithms that analyze and plot only the row items (here, stimuli), or only the column items (here, verbs), or both (as in the joint plots, see §6.3.3.1).

Figure 6.7 shows patterns similar to those reported in both §6.3.3.1 (action verbs) and §6.3.3.2 (result verbs). Recall that in Figure 6.3 – a plot of the stimuli based only on the action verbs (V_1), shown earlier – events of cutting with a double-bladed instrument were distinguished along the first dimension from events of breaking by hand (snapping and tearing), and along the second dimension from events of cutting with a single-bladed instrument. In Figure 6.7 we also see that events involving a double-bladed instrument (stimuli 1, 21, 27, 5, 15, to the right) are distinguished from events of snapping (2, 18, 7, upper left corner) and tearing (5, 4, 14, 16, 20, upper center), as well as from events involving a single-bladed instrument (3, 8, 17, 9, 24, 28, 11, 13, 26, lower center). But the clusters are not as tight as in Figure 6.3 because the positioning of the stimuli is also affected by the information coming from the result verbs (see Figure 6.5). For example, stimulus 2 (breaking a twig by hand) is often described with the RVC *bai1-duan4* 'bend-be broken crosswise (of linear object)'. This means that it must be positioned not only near 7 (breaking a baguette) and 18 (breaking a chocolate bar), the other two stimuli that involve a bending or snapping force, and so share V_1 (*bai1*), but also near 23 (cutting a bunch of spring onions), an event that does not involve bending and so has a different V_1 but does involve the crosswise severing of a linear object and so shares V_2 (*duan4*).

Now with the general event map provided by Figure 6.7 in hand, let us compare the event categories associated with the core action verbs and other high frequency action verbs across the age groups. To allow more space for indicating the verbs and their boundaries, I use a version of Figure 6.7 in which short descriptions of the stimuli are substituted for the still frames. First we take a look at the event categories associated with the action verbs, and then the result verbs.

Event boundaries of the action verbs across age

The four core action verbs are *jian3* 'cut with a double-bladed instrument crosswise (of linear object)', *qie1* 'cut with a single-bladed instrument', *bai1* 'bend', and *si1* 'tear, rip', The following plots show the event boundaries associated with these verbs, plus certain additional relatively high frequency verbs, for each age group separately (first the adults and then the child groups, ordered by increasing age):

- Figure 6.8_*adults*, Categorization of C&B action events by the adults
- Figure 6.8_*2;6*, Categorization of C&B action events by the 2;6-year-olds
- Figure 6.8_*3;6*, Categorization of C&B action events by the 3;6-year-olds

- Figure 6.8_*4;6*, Categorization of C&B action events by the 4;6-year-olds
- Figure 6.8_*6;1*, Categorization of C&B action events by the 6;1-year-olds

The verbs are shown in capital letters, and the event boundaries associated with them are demarcated by dotted lines.[54] My criterion for including a stimulus event within the event boundary of a particular verb was that at least 4 of the 10 participants in that age group used the verb to describe the event (40% agreement). Under each stimulus description there is a number representing how many of the 10 participants in fact used the verb; important alternative responses are indicated as well.

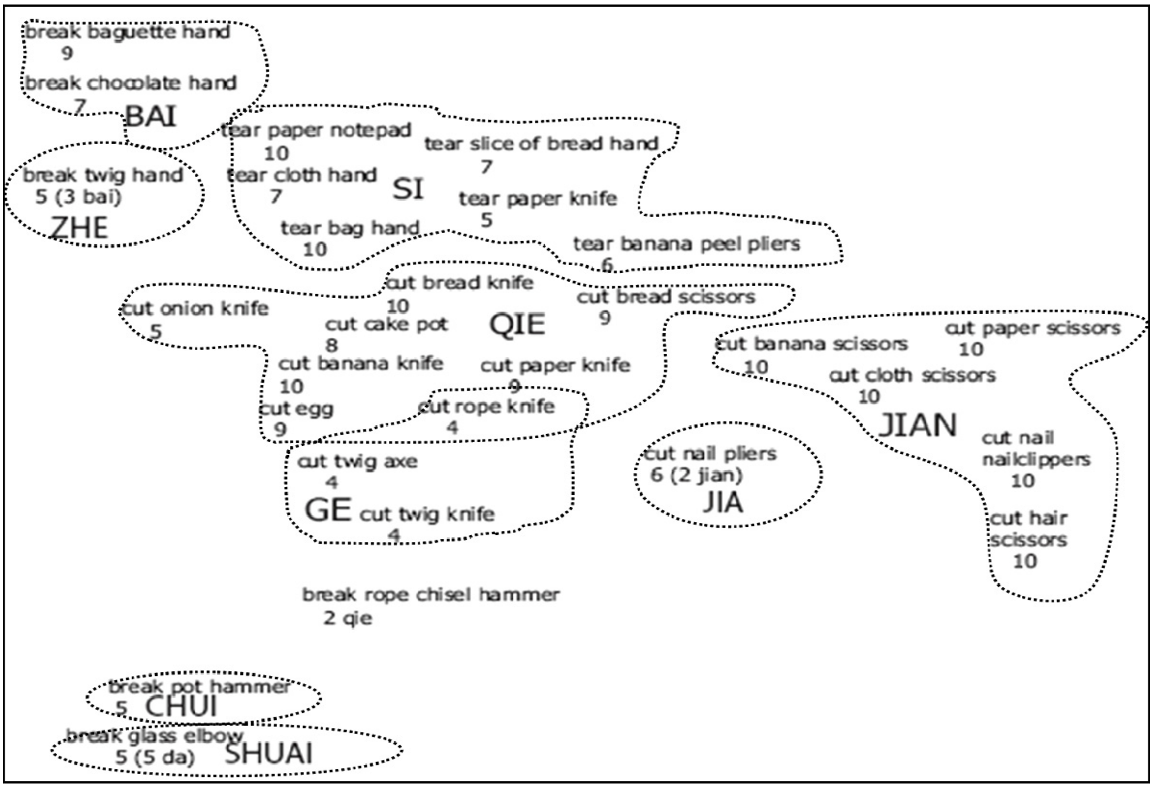


Figure 6.8_*adults*. Categorization of C&B action events by the adults

jian3 ‘cut with a double-bladed instrument’ (e.g., scissors)
qie1 ‘cut with a single blade or blade-like instrument’ (e.g., knife)
si1 ‘tear, rip’
bai1 ‘bend’
zhe2 ‘bend by hand (of thin linear object)’
da3 ‘hit’
chui1 ‘hammer’
ge1 ‘cut with a single-bladed instrument slowly, back and forth’
shuai1 ‘drop, fall’
jia2 ‘hold.tightly, squeeze’
gao3 ‘make, do’

[54] Numbers representing the tones are not indicated in these plots to avoid confusion with numbers representing the frequency of the verbs.

(Note a: Some of these verbs do not in themselves denote cutting or breaking actions, but rather an action such as "hitting" that may cause the separation or destruction of an object.)

(Note b: The total number of action verbs for a stimulus does not always add up to 10 because verbs used by fewer than two participants are not indicated on the plot.)

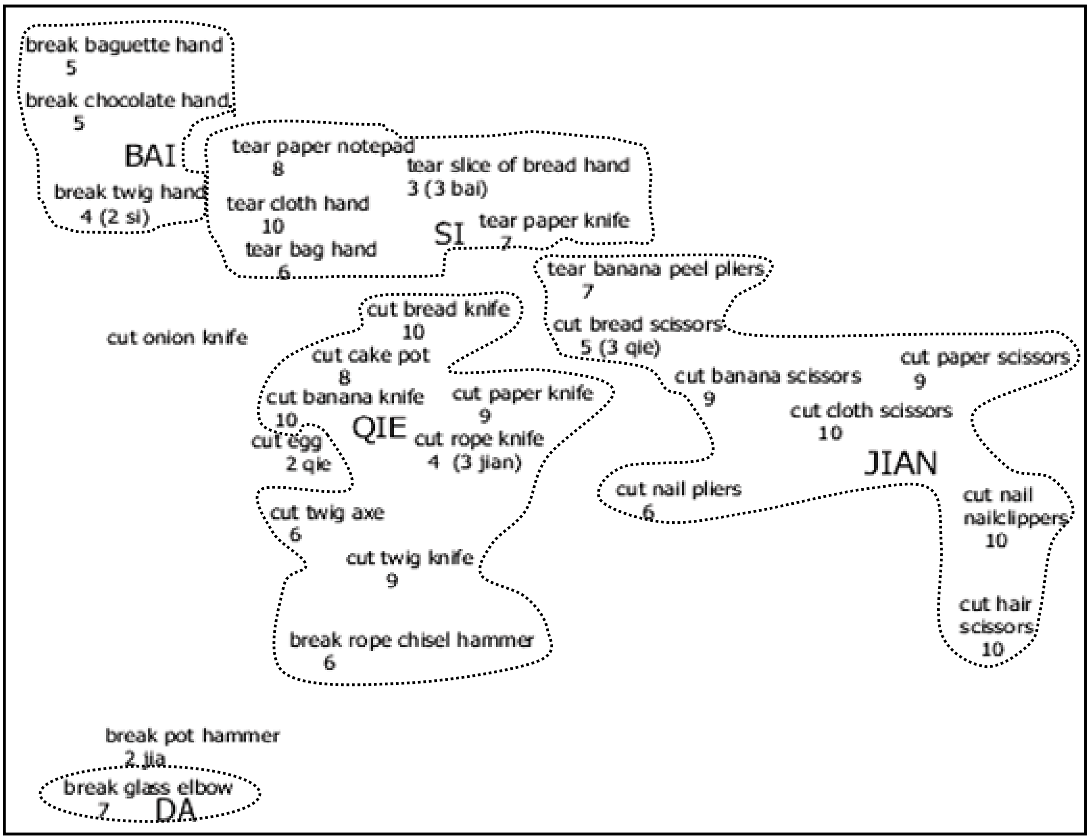


Figure 6.8_*2;6*. Categorization of C&B action events by the 2;6-year-olds

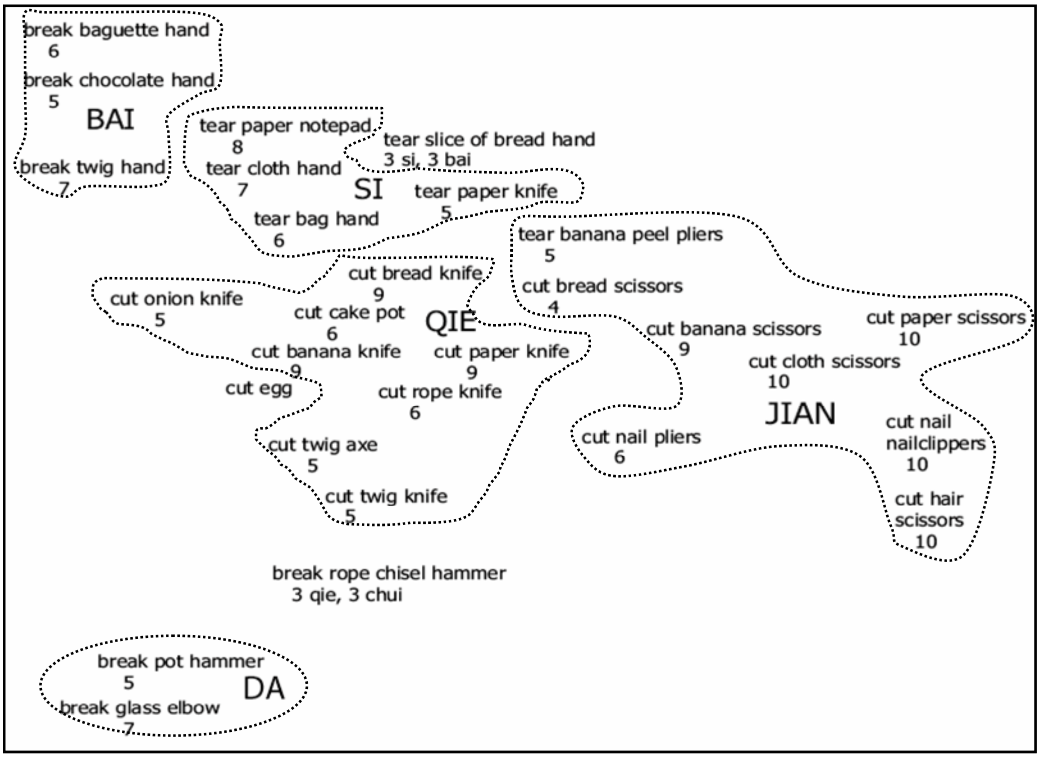


Figure 6.8_*3;6*. Categorization of C&B action events by the 3;6-year-olds

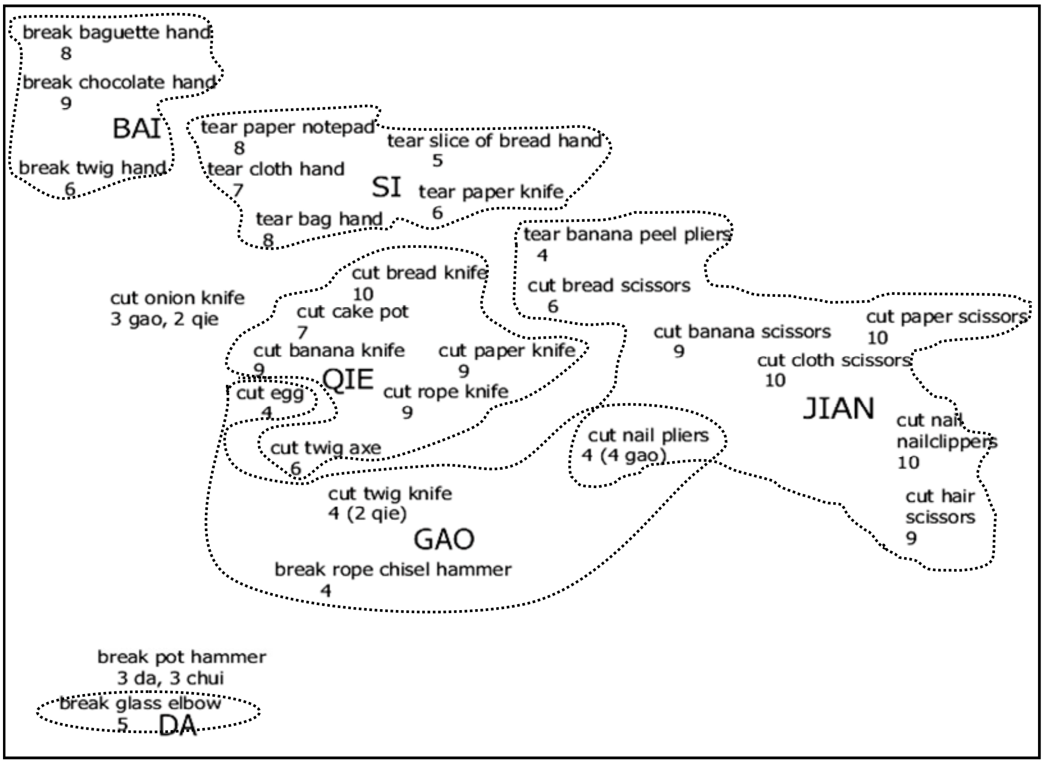


Figure 6.8_*4;6*. Categorization of C&B action events by the 4;6-year-olds

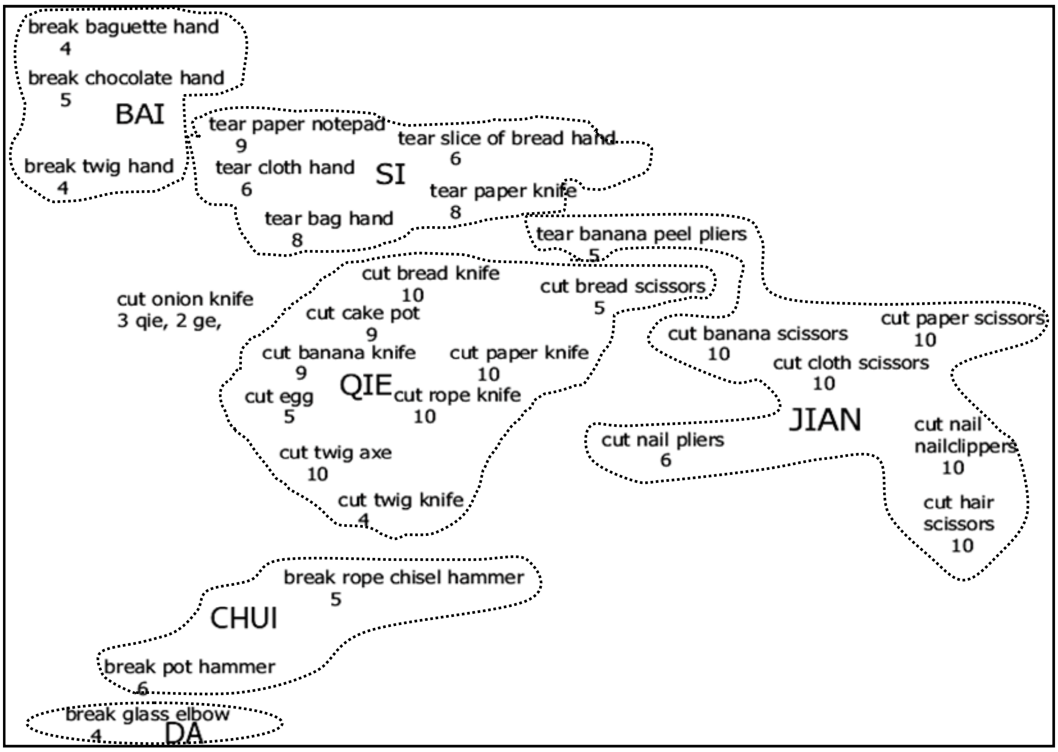


Figure 6.8_*6;1*. Categorization of C&B action events by the 6;1-year-olds

Figures 6.8_*2;6* to 6.8_*adults* confirm the similarities and differences across the age groups in event categorization found in the previous analyses, and illustrate them more concretely. The children and adults share the same four big action event categories, and agree on what verb to use for them: *jian3* 'cut with a double-bladed instrument', *qie1* 'cut with a single-bladed instrument', *bai1* 'bend', and *si1* 'tear, rip'. Within each action category, children used the verb about as often as adults do. For example, all the age groups used *si1* for 'tear, rip' at least 8 times for "tearing a piece of paper from a notepad", even the 2;6-year-olds. These figures also show that both the adults and the children have a *da3* 'hit' category for breaking a glass (lower left corner of the plots).

But the children and adults differ subtly in their choice of action verbs. Most obviously, the adults have more event categories than the children. For example, they have an event category of *ge1* 'cut with a single-bladed instrument slowly, back and forth' (lower left center of Figure 6.8_*adults*), while the children used this verb only marginally (e.g., two 6;1-year-olds used *ge1* for cutting spring onion against a static knife, see Figure 6.8_*6;1*); they tended to use *qie1* instead, and the 4;6-year-olds also used the verb *gao3*, which simply means 'make' or 'do' (lower center of Figure 6.8_*4;6*). The adults also have two event categories for snapping events – *bai1* 'bend' and *zhe2* 'bend by hand (of thin linear object)' (upper left corner of Figure 6.8_*adults*) – whereas the children have only the *bai1* category.

As discussed in §6.3.1, *zhe2* is used for thin linear objects and sounds more literary, whereas *bai1* is applied to all linear objects (not necessarily thin). The adults have another event category, *jia2* 'hold.tightly, squeeze' for cutting the head of a nail with a pair of pliers (lower right center), whereas the children used *jian3* 'cut crosswise with a double-bladed instrument' (which is acceptable but less popular than *jia2* since pliers are not as prototypical of the *jian3* category as scissors). The adults also have a *chui2* 'hammer' category for breaking a pot with a hammer, whereas only the 6;1-year-olds used *chui2* consistently for this event, and they differ from the adults in overextending *chui2* to breaking a rope by using hammer to hit a chisel whose blade is on the rope (stimulus 26). In this particular case, it is the blade of the chisel that directly causes the breaking of the rope, not the hammer, so it is inappropriate to use *chui1*, and none of the adults did so (two of them used *qie1* 'cut with a single-bladed instrument' and the others used different verbs due to the unusual manner of cutting in this stimulus). In addition, the adults have an event category *shuai1* 'drop, fall' for breaking a glass by accidentally knocking it off the table with an elbow (stimulus 25), whereas the children tended to use *da3* 'hit' instead. According to my own native speaker intuitions, both verbs are acceptable; the use of *shuai1* seems to focus on the trajectory of the falling cup.

These plots also confirm the overuse of certain verbs that was seen in the previous analyses. For example, the adult *jian3* category includes all and only the events in which scissors or clippers were used in a canonical way to cut something, but children even as old as six used *jian3* for other events involving a double-bladed tool, such as "tearing a banana peel in two with pliers" (*si1* 'tear, rip' for adults) and "cutting bread with a single blade of a pair of scissors" (*qie1* 'cut with a single-bladed instrument' for adults).

Overall, this analysis shows that the adults have more event categories than the children of all age groups. This is not surprising, given that adults have a richer vocabulary and they know and use synonyms (if there are any) of the high frequency verbs, or verbs that are fine-tuned to the action in the stimuli. Despite the difference in vocabulary size, we can still see that children agree strongly with adults on the event categories associated with the core verbs.

Event boundaries of the result subevents categorized by the core result verbs across age

For the result verbs, I applied the same procedure as I used with the action verbs, with one difference: the criterion for including a stimulus within an event category was lowered from at least 4 to at least 3 of the 10 participants in each age group (30% agreement). Even this more lenient criterion was rarely met in the two youngest children's groups (see Table 6.4), so it was impossible to draw any coherent boundaries for these groups. Figures 6.9_*4;6,* Figure 6.9_*6;1*, and Figure 6.9_*adults* show the results for the two oldest child age groups and the adults. The event boundaries are indicated by dotted lines, each representing event categories associated with one of the three core result verbs.

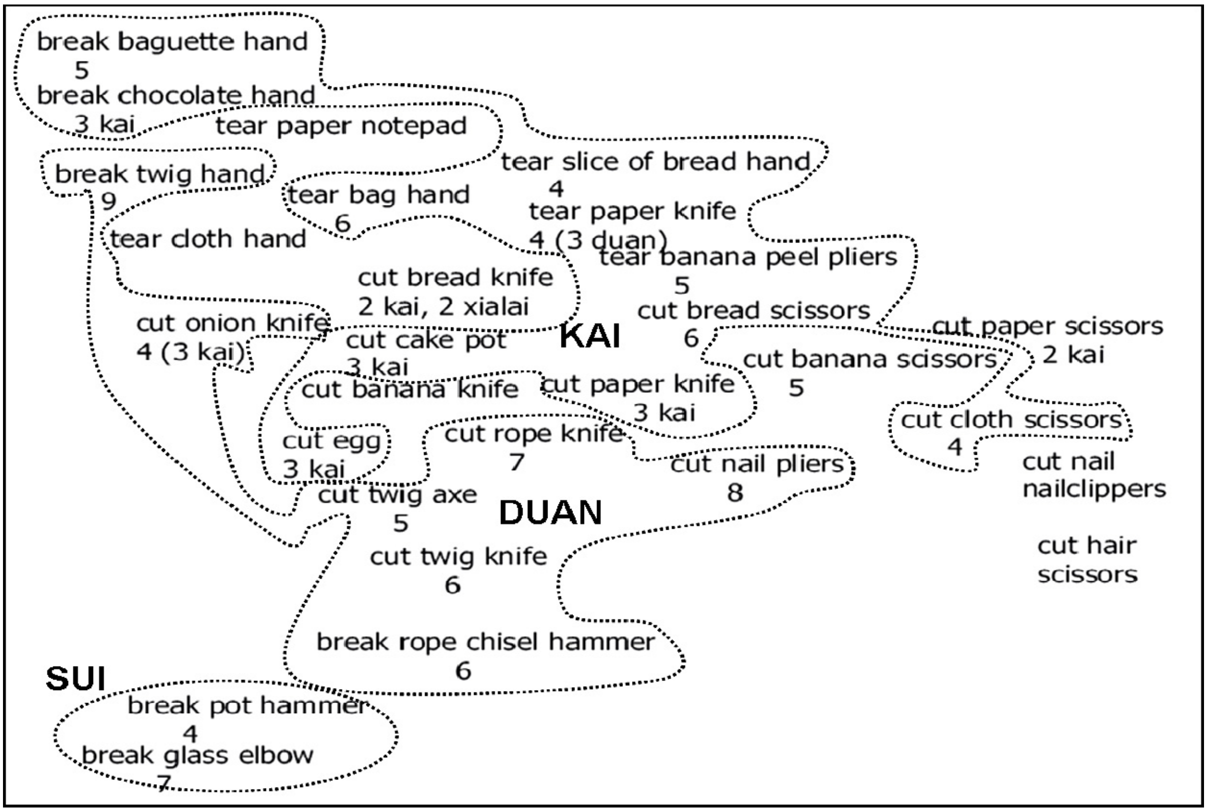


Figure 6.9_*adults*. Categorization of C&B result events by the adults

kai1	'be open, apart'
duan4	'be broken crosswise (of linear object)'
lan4	'be smashed, in pieces, tattered, rotten'
sui4	'be smashed, in pieces'

(Note: The total number of result verbs for a stimulus does not add up to 10 for two reasons: not all participants provided a result verb for each stimulus, and verbs used for a stimulus by fewer than two participants are not indicated on the plot.)

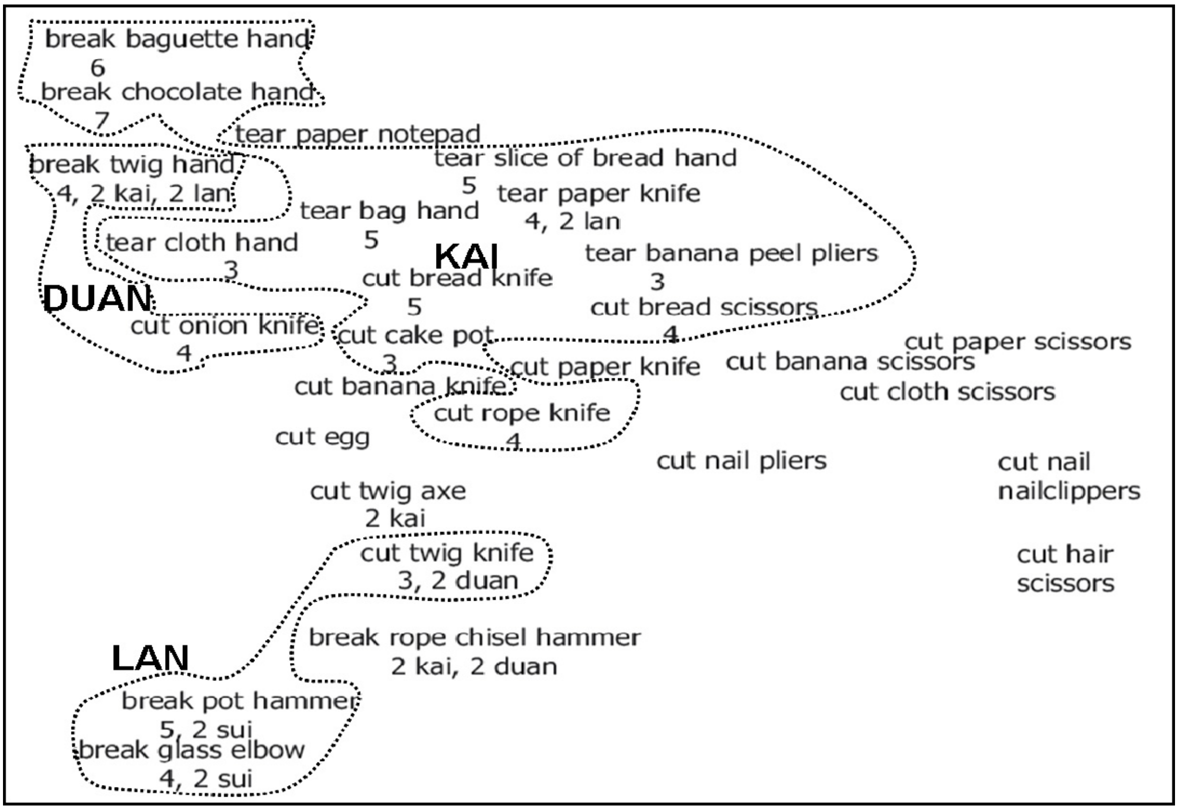


Figure 6.9_*4;6*. Categorization of C&B result events by the 4;6-year-olds

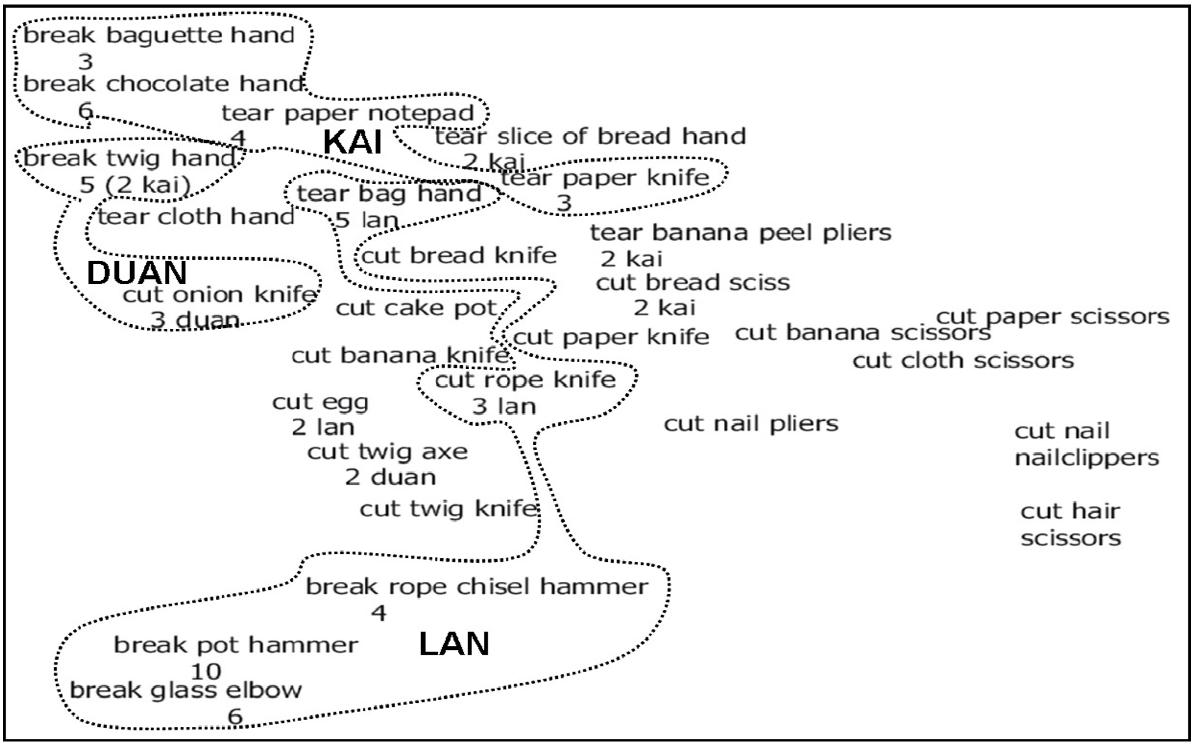


Figure 6.9_*6;1*. Categorization of C&B result events by the 6;1-year-olds

These figures allow us to visualize the major patterns found in the previous analyses of the result verbs. For example, the adult categories of *duan4* 'be broken crosswise (of linear object)' and *kai1* 'be open, apart' are larger than those of the two children's groups. This confirms that the adults are more generous and consistent than the children in their uses of these verbs. The children tended to use *lan4* 'be smashed, in pieces, tattered, rotten' or *kai1* 'be open, apart' for some events in the adult *duan4* category (e.g., cutting rope with knife, cutting twig with knife). The children did not show a category of *sui4* 'be smashed, in pieces' as the adults did; this category was replaced by the category of *lan4* 'be smashed, in pieces, tattered, rotten'. As discussed before, the children overused *lan4*, applying it to events for which adults did not use it at all.

So far I have compared the event boundaries across the age groups separately for the action verbs and the result verbs. But recall that Mandarin speakers – even very young children – routinely using an RVC that encodes both the action subevent and the result subevent in the same complex predicate (see Chapter 4). Action verbs and result verbs do not encode the same semantic information or categorize events in the same way. This means that in order to select or construct an adult-like RVC, children have to break down an event into two distinct subevents, each one belong to a different event category. These different categorizations of the same set of C&B events can be compared.

Let us compare, for example, Figures 6.8_*4;6* and 6.9_*4;6*, the action vs. result event maps for the 4;6-year-old children. In the action event map (Figure 6.8_*4;*6) the *bai1* 'bend' category includes three stimuli, breaking a baguette by hand, breaking chocolate by hand, and breaking a twig by hand (upper left corner of the figure). In the result event map (Figure 6;9_*4;6*) these three stimulus events are categorized differently: the first two belong to the *kai1* 'be open, apart' category and the third to the *duan4* 'be broken crosswise (of linear object)' category. Another action category of the 4;6-year-olds, *si1* 'tear, rip', includes five stimuli involving tearing a 2-dimensional object (upper center of Figure 6.8_*4;6*). Four of these action events also fall into the *kai1* result category (upper center of Figure 6.9_*4;6*), but the *kai1* category is much larger, and also includes not only most of the *si1* 'tear, rip' events but also some of the events encoded with the action verbs *qie1* 'cut with a single-bladed instrument' and *jian3* 'cut with a double-bladed instrument'.

These examples show that the event categories of the action verbs and the result verbs crosscut each other, and that children systematically learn to categorize C&B events in two different ways from at least 4;6 years of age.

6.4 Discussion and conclusions

In this chapter I have focused on the development of the fine-grained lexical semantics of the action and the result verbs that Mandarin speakers use in describing events of cutting and breaking. The data analyzed were short elicited descriptions of 28 video clips of C&B events from four groups of children (mean ages 2;6, 3;6, 4;6, and 6;1) and a group of adult native speakers. A number of different methods were used to analyze the data. These include comparisons across age groups of the frequency of the core action verbs and result verbs for each stimulus; confusion matrices showing mutual substitutions among verbs; correspondence analyses showing the overall classification of the stimulus events by the action verbs and the result verbs, as well as how these verbs were used by the different age groups; and plots showing the placement of action and result event boundaries across age groups.

These analyses show that learners of Mandarin are sensitive to Mandarin-specific semantic distinctions from a very young age. For example, even the 2;6-year-olds make a consistent distinction between cutting with a single-bladed instrument (*qie1*) and cutting with a double-bladed instrument (*jian3*). As noted earlier, Erkelens (2003) has observed similar language specificity in learners of Dutch, a language in which the distinction between single-bladed and double-bladed cutting is also obligatory. But the youngest children in Erkelens' study were 4;6. Here we see that children can already make this distinction by as much as two years earlier!

Despite their skill at homing in on language-specific meanings for C&B verbs, children do not weight the verbs' semantic features exactly as adults do. The treatment of instruments provides a good example. In my study, Mandarin speakers of all ages weight "instrument" – distinctions among various instruments such as scissors, knife, or hand – as the primary semantic feature determining the choice of a C&B action verb (cf. dimension 1 in Figure 6.3). But young children focus primarily on the *identity* of the instrument, and do not yet realize that they must also attend to the part of the instrument that is involved and how it is applied – e.g., the "double-bladed cutting" verb usually associated with scissors is inappropriate for describing an event of cutting with a single scissor blade or an event of tearing with a double-bladed instrument. Such errors are still found as late as age six.

The finding that children orient early to the overall identity of an instrument used to carry out an action is consistent with observations of children learning languages typologically distinct from Mandarin. For example, young learners of English often judge *cut* to be an acceptable description of an event of breaking a bottle with a pair of scissors (Schaefer, 1979). Learners of English, German, and French often use names for instruments as novel verbs regardless of how they are used, e.g., "I broomed her" (hit her with a broom), "I'm going to pliers this out" (taking spaghetti out of a pan with tongs) (Clark, 1981, 1982). And English-speaking children often choose instrument verbs such as *hammer* or *saw* to describe experimental events in which an adult uses an instrument to perform an action that brings about a state change (e.g., pounding nails into two boards with a hammer, thereby connecting them) (Behrend, 1990).

Result verbs also provide examples of differences between children and adults in the weighting of the semantic features. Learners of Mandarin show some knowledge of the relevant semantic features of result verbs, but they have not yet fully established which semantic features are distinctive for categorizing a C&B result subevent as an instance of a particular category. For example, although Mandarin learners do use *duan4* 'be broken crosswise (of linear object)' appropriately for some events involving linear objects, their *duan4* is much more restricted than that of adults; they are more likely to overextend *lan4* 'be smashed, in pieces, tattered, rotten' to events consistently called *duan4* by the adults.

These findings are relevant to larger theoretical concerns about how children learn the mapping between linguistic forms and their meanings. Chapter 3 outlined the view – widespread since the 1970's – that the concepts to which words are initially mapped are universal, provided by children's nonlinguistic conceptual development. But recent crosslinguistic research has challenged this view, showing that languages vary more in their semantic categorization of events than had been realized and that children display early sensitivity to language-specific categories. My study contributes to this debate by showing that learners of Mandarin home in on the Mandarin-specific semantic organization of "cutting and breaking" verbs at a very early age. By as young as 2;6 they have already learned how to parse C&B events into both an action subevent and a result subevent, each encoded with its own verb. They can use the verbs independently of one another, alone or in combination with other action or result verbs. And they attend to the crucial semantic features that define the event categories picked out by these verbs. Children do make errors in their use of C&B verbs, but these errors run along the lines of the semantic features that are indeed important in Mandarin; for example "instrument" (cf. the overextension of the double-bladed cutting verb, *jian3*, for events in which a single blade of a pair of scissors is used like a knife). Taken together, my results support and add to the growing body of evidence that children tune in early to language-specific semantic structures.

LEARNING THE ARGUMENT STRUCTURE OF RESULTATIVE VERB COMPOUNDS

CHAPTER 7

7.1 Introduction

In the previous chapter I explored children's understanding of the fine-grained semantics of the component verbs of resultative verb compounds. Besides having a meaning, each component verb of an RVC also has an argument structure – one or more arguments associated with it in a particular syntactic configuration. When these verbs come together in an RVC, their argument structures must be combined to form a single argument structure for the compound as a whole. In this chapter, I investigate what children know about this process.

Children's acquisition of argument structure has been widely discussed in the acquisition literature, with particular emphasis on how learners link semantic roles to syntactic roles and how they acquire constraints on argument structure alternations in the absence of negative feedback. But theorizing has revolved almost exclusively around single verbs. Mandarin RVCs pose a more complex situation. Since an RVC comprises two (or more) predicates, the speaker must decide which arguments go with which predicate, and what semantic role each argument plays in the overall interpretation of the sentence; to complicate matters, arguments are often shared between the predicates or left unexpressed. One might suppose that up to a certain age children simply memorize the conventional mapping of arguments for each RVC separately. But, as I have demonstrated in Chapter 4, verb compounding becomes productive from as young as age 2;6. To achieve productivity, children must learn more abstract patterns of argument assignment and argument sharing.

This chapter presents an empirical study of Mandarin-speaking children's knowledge of the argument mappings between the component verbs of an RVC. More specifically, it focuses on transitive RVCs that take two arguments in the syntactic frame NP1 RVC NP2. Even in such a seemingly straightforward case, there are many ways these two arguments can be mapped onto the arguments of the two component verbs of the RVC, as I explain in §7.2. In §7.3 I present an experiment that investigates children's interpretations of argument-structure assignment in RVCs, and in §7.4 I discuss the findings and draw some conclusions.

7.2 Argument structure of transitive RVCs

The argument structure of an RVC as a whole is related to the argument structure of its component verbs (e.g., Y.-F. Li, 1990; Shen, 1993), but the mapping between verbs and arguments is by no means obvious. In some cases arguments are shared, i.e., an argument of the compound as a whole is an argument of both of the component verbs. In other cases, certain arguments of the component verbs remain unexpressed. As discussed in Chapter 3, the component verbs of RVCs come from open sets and may be either transitive or intransitive. V_1 is usually an action verb indicating the cause, while V_2 is a stative verb including adjectival verbs or a verb indicating an action caused by V_1. The wide range of verbs allowed in the V_1 and the V_2 slots means that there are many conceivable ways to assign the arguments of the component verbs to the RVC as a whole. Is the assignment constrained in some way such that children do not have to consider every logical possibility?

In English, as discussed Chapter 3, result phrases in resultative constructions can only be predicated of the (surface or underlying) object of the verb (Levin & Rappaport Hovav, 1995; see also Simpson, 1983):

(81) a. Mary wiped the table_i clean_i.

b. The door_i was kicked open_i.

Ungrammaticality arises when in the intended reading the predication of the resultative phrase is assigned to the subject of the sentence:

(82) a.*Mary$_i$ wiped the table hot$_i$.

(This cannot mean that Mary wiped the table until she was hot.)

b.*Mary$_i$ ate the food full$_i$ / sick$_i$.

(This cannot mean that Mary ate until she was full/sick.)

If this constraint were universal, children might know ahead of time to apply it and so have fewer mapping possibilities to consider. But the constraint does not hold for Mandarin RVCs, where the result verb V_2 of an RVC can be predicated of the subject as well as the object:

(83) *Wo3$_i$* ***chi1-bao3$_i$*** *le* *fan4.*

I **eat-be.full** PFV food

'I ate (myself) full of food.'

It seems likely, then, that rules for argument assignment in RVCs are to a large extent specific to Mandarin. What can we say about these rules?

According to Y.-F. Li (1990), the argument structure of an RVC can be predicted on the basis of the transitivity of its component verbs. Li distinguishes four types of RVCs according to their argument linking patterns, as discussed just below. The total number of arguments selected by the two component verbs of a transitive RVC may exceed two (e.g., when one or both component verbs are transitive), and the two verbs may share some arguments.

Type 1: **No sharing of arguments between the component verbs.** In this case both V_1 and V_2 are intransitive (RVC = $V_{1\text{-INTR}}V_{2\text{-INTR}}$), so each component verb selects only one argument. But the compound as a whole selects two arguments. The rule here is that the first (i.e., external) argument (NP_1) of the RVC is the single argument of V_1, and the second (i.e., internal) argument (NP_2) of the RVC is the single argument of V_2. This is illustrated in (84).

(84) *Mei4mei* *ku1-pao3* *le* *ge1ge.*

Younger.sister cry-run PFV brother

'The younger sister cried, causing older brother to run away.'

Sentence (84) cannot mean ‘Brother cried, causing sister to run away’, or ‘Sister cried, causing sister to run away from brother’.

Type 2: **Sharing of both arguments**. In this case, V_1 and V_2 are both transitive (RVC = $V_{1\text{-TR}}V_{2\text{-TR}}$) and there is full argument sharing: the first and second arguments of the RVC correspond to the first and second arguments of both V_1 and V_2. For example:

(85) *Lao3hu3 yao3-shang1 le hui1lang2.*

Tiger bite-wound PFV grey.wolf

‘The tiger wounded the grey wolf by biting him.’

In sentence (85), *yao3-shang1* ‘bite-wound’ and its component verbs both select the same two arguments <tiger, wolf> in the same semantic and syntactic roles. This sentence cannot mean, for instance, ‘The wolf bit the tiger and the wolf got wounded as a result.’

Type 3: **Sharing of the first argument**. In this case, V_1 is intransitive and V_2 is transitive (RVC = $V_{1\text{-INTR}}V_{2\text{-TR}}$). The first argument of the RVC as a whole is both the single argument of V_1 and the first argument of V_2, and the second argument of the RVC is the second argument of V_2. For example:

(86) *Xiao3gou3 pao3-diu1 le xiao3mao1.*

Doggie run-lose PFV kitty

‘Doggie ran and as a result he lost kitty.’

Here, the first argument of the RVC, *xiao3gou3* ‘doggie’, is shared between the two verbs; it is the only argument of V_1 *pao3* ‘run’ and the first argument of V_2 *diu1* ‘lose’. The second argument of the RVC, *xiao3mao1* ‘kitty’, is an argument only of V_2.

Type 4: **Multiple sharing patterns.** When V_1 is transitive and V_2 is intransitive (RVC = $V_{1\text{-TR}}$ $V_{2\text{-INTR}}$), arguments may be assigned in more than one way. In some RVCs of this form (type 4a), it is the *first* argument of the compound that is shared between the verbs, as in sentence (83). Here, the first argument of *chi1-bao3* ‘eat-be full’ (*wo3* ‘I’) is the first argument of V_1 *chi1* ‘eat’ and the only argument of V_2 *bao3* ‘be full’. The second argument of this RVC, *fan4* ‘food’, is the second argument of V_1 *chi1*’eat’, but it is not an argument of *bao3* ‘be full’.

In other RVCs of this form (type 4b), it is the *second* argument of the RVC that is shared between the verbs, as illustrated in (87):

(87) *Ma1ma hong3-shui4 le bao3bao.*

Mother coax-sleep PFV baby

'The mother coaxed the baby to sleep (e.g., by singing lullabies).'

Here, the second argument of the RVC *hong3-shui4* 'coax-sleep' (*bao3bao* 'baby') is the second argument of V_1 *hong3* 'coax' and the only argument of V_2 *shui4* 'sleep'. The first argument of the compound (*ma1ma* 'mother') is an argument only of V_1.

If the V_2 of a type 4 RVC ($V_{1\text{-TR}}$ $V_{2\text{-INTR}}$) comes from the semantic class of psych verbs (type 4c), it may be interpreted in more than one way, as shown in (88):

(88) *Xiao3gou3 zhui1-lei4 le xiao3mao1.*

Doggie chase-be.tired PFV kitty

a. 'Doggie chased kitty and as a result doggie got tired.' (Sharing of first argument)

b. 'Doggie chased kitty and as a result kitty got tired.' (Sharing of second argument)

c. 'Doggie caused kitty to get tired due to kitty's chasing doggie.' (Sharing of second argument: NP_1 is the *second* argument of V_1 and NP_2 is its *first* argument; NP_2 is the first and only argument of V_2)

The argument-sharing patterns described (88a) and (88b) are relatively straightforward. The pattern in (88c) needs some explanation. In this interpretation, like that in (88b), it is the second argument of the RVC *zhui1-lei4* 'chase-tire' (i.e., *xiao3mao1* 'kitty') that is shared between the two component verbs, but the order of argument assignment is inverted. Although *xiao3mao1* 'kitty' is the *second* argument of the RVC, it is the *first* argument of V_1 *zhui1* 'chase', as well as the single argument of V_2 *lei4* 'be.tired'. And although *xiao3gou3* 'doggie' is the *first* argument of the RVC, it is the *second* argument of V_1 *zhui1* 'chase'. This third interpretation is not rare (cf. Y.-F. Li, 1990, 1995). Another example of it is:

(89) *Zhe4 jian4 gong1zuo4 gan4-lei4 le Li3si4.*

This CLF job perform-be.tired PFV Lisi

'This job caused Lisi to be tired due to her performing it.'

In this sentence, the first and second arguments of the RVC *gan4-lei4* 'perform-be.tired' are the second and first arguments, respectively, of V_1 *gan4* 'perform' – i.e., it is Lisi who performs the job, not the job that performs Lisi.

Table 7.1 summarizes these different types of RVCs and their argument sharing patterns, each with a sample sentence in English gloss.

Table 7.1. Different types of RVCs and their argument assignment patterns

RVC type	**Argument assignment patterns**	**Schema**
Type 1 $\mathbf{V_{1\text{-INTR}}\,V_{2\text{-INTR}}}$	No sharing of arguments e.g., 'Sister cry-run brother.'	(A) NP_1 $V_{1\text{-INTR}} + V_{2\text{-INTR}}$ NP_2
Type 2 $\mathbf{V_{1\text{-TR}}\,V_{2\text{-TR}}}$	Sharing of both arguments e.g., 'Tiger bite-wound wolf.'	(B) $\mathbf{NP_1}$ $V_{1\text{-TR}} + V_{2\text{-TR}}$ $\mathbf{NP_2}$
Type 3 $\mathbf{V_{1\text{-INTR}}\,V_{2\text{-TR}}}$	Sharing of the first argument e.g., 'Doggie run-lose kitty.'	(C) $\mathbf{NP_1}$ $V_{1\text{-INTR}} + V_{2\text{-TR}}$ NP_2
Type 4 $\mathbf{V_{1\text{-TR}}\,V_{2\text{-INTR}}}$	a. Sharing of the first argument e.g., 'I eat-be full food.'	(D) $\mathbf{NP_1}$ $V_{1\text{-TR}} + V_{2\text{-INTR}}$ NP_2
	b. Sharing of the second argument e.g., 'Mummy coax-sleep baby.'	(E) NP_1 $V_{1\text{-TR}} + V_{2\text{-INTR}}$ $\mathbf{NP_2}$
	c. Multiple sharing possibilities (V_2 = psych verbs) e.g., 'Doggie chase-be.tired kitty.'	(D), (E), or (F) $\mathbf{NP_2}$ $V_{1\text{-TR}} + V_{2\text{-INTR}}$ NP_1

(Note: Arrows points to the argument(s) of the component verbs. Those *above* each schema in the third column indicate the arguments of the V_1, and those *below* indicate the arguments of the V_2. Shared argument NPs are indicated in bold and bigger font size.)

To sum up, argument assignment is systematic for transitive RVCs with two overt arguments. For three types of RVCs (types 1, 2, and 3), the transitivity of the component verbs predicts the argument assignment patterns perfectly. Only for type 4 RVCs ($V_{1\text{-TR}}V_{2\text{-INTR}}$) does an extra variable – the semantics of V_2 – play an important role in determining the argument assignment patterns. For RVCs with only one possible interpretation (types 1, 2, 3, 4a, 4b), the order of the arguments of V_1 and V_2 is the same as the order of the arguments of the RVC (e.g., the first argument of the RVC must be the first argument of the V_1). For RVCs with multiple possible interpretations (type 4c), the order of the argument of V_1 and V_2 may match that of the arguments of the RVC (schemas D, E), but may also be inverted (schema F).

7.3 Learning the argument structure of transitive RVCs

How do children learn the argument assignment patterns associated with different kinds of RVCs? Do they just assign arguments randomly, or do they systematically associate different RVC types with different patterns? To find out, I designed and conducted the *Argument Structure Cartoon* experiment.

7.3.1 Experiment 5: The Argument Structure Cartoon experiment

Stimuli

This experiment investigates children's knowledge of the argument structure of five types of RVCs: types 1, 2, 3, 4b, and 4c. For simplicity, type 4b is relabeled as type 4 and type 4c as type 5. Type 4a (e.g., *chi1-bao3* 'eat-be.full') was not included because pragmatically it does not lend itself to incorrect interpretations; e.g., 'I eat-be.full rice' cannot possibly mean 'Rice ate me and rice got full'. RVC types 1, 2, 3, and 4 (originally 4b) are not pragmatically constrained in this way, but for adults they have only one possible interpretation, e.g., 'Sister cry-run brother' means that the sister causes the brother to run away by crying; it cannot mean that the sister cries and runs away from the brother or that the brother cries and the sister runs away. Type 5 RVCs (originally 4c) are $V_{1\text{-}TR}$ $V_{2\text{-}INTR}$ combinations with psych verbs, so they are three-way ambiguous, to judge from both the literature and my own native speaker intuitions.

For each of the five RVC types, I formulated two test sentences; these are shown in Table 7.2 in English gloss. All the NPs were animate to ensure that children could not simply use pragmatic cues (e.g., choose an animate noun as agent and an inanimate noun as patient), but had to draw on their knowledge of argument assignment to arrive at the correct interpretation.

Table 7.2. Test sentences for five transitive RVC types

RVC type	**Argument assignment patterns**	**Test sentences** (English gloss)
Type 1 $V_{1\text{-INTR}}$ $V_{2\text{-INTR}}$	No sharing of arguments	1. 'Sister **cry-run** brother.' 2. 'Kitty **laugh-wake** doggie.'
Type 2 $V_{1\text{-TR}}$ $V_{2\text{-TR}}$	Sharing of both arguments	3. 'Doggie **fight-win** kitty.' 4. 'Wolf **bite-wound** tiger.'
Type 3 $V_{1\text{-INTR}}$ $V_{2\text{-TR}}$	Sharing of the first argument	5. 'Doggie **run-lose** kitty.' 6. 'Kitty **play-forget** doggie.'
Type 4 $V_{1\text{-TR}}$ $V_{2\text{-INTR}}$	Sharing of the second argument	7. 'Mother **sing.lullaby-sleep** baby.' [64] 8. 'Kitty **topple-fall** doggie.'
Type 5 $V_{1\text{-TR}}$ $V_{2\text{-INTR}}$	Multiple sharing possibilities	9. 'Doggie **chase-be.tired** kitty.' 10. 'Tiger **beat-be.frightened** wolf.'

Corresponding to each test sentence are three short animated cartoon clips, each about 10 to 15 seconds long, for a total of 30 clips. These offer possible interpretations of the test RVC. For RVC types 1 to 4, only one of the three clips depicts the correct interpretation of the RVC, while the other two show mismatching events involving the same characters. Figure 7.1 illustrates this design with sample still frames from the three cartoon depictions of test sentence no. 1, *Mei4mei ku1-pao3 le ge1ge* 'Sister cry-run brother'. Only the first depiction is correct: it is the sister who cries and the brother who runs away. RVC type 5 allows multiple patterns of argument assignment, and all three clips represent possible interpretations.

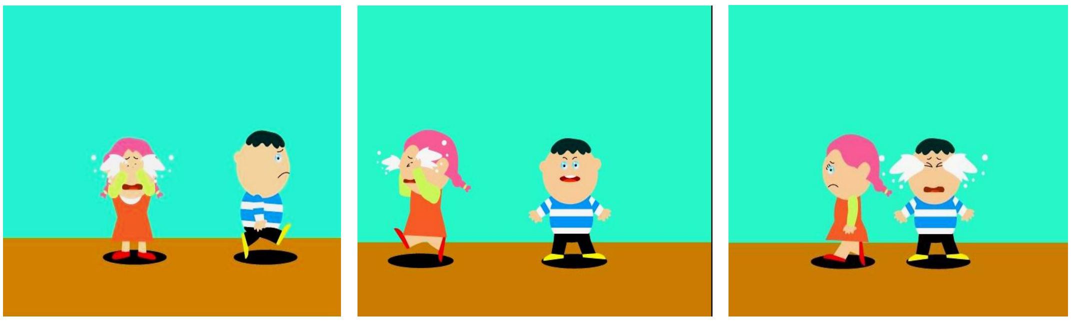


Figure 7.1. Sample still frames from the three cartoons clips testing the interpretation of the sentence 'Sister cry-run brother'

A single trial presents a test sentence paired with one of its three clips. All participants were given the entire battery of 30 trials (3 clips × 10 sentences). These trials were divided into 3 blocks, shown on different days, so that each child received only one trial for a given test sentence on any given day. The order of the trials was counterbalanced: each block of

[64] Test sentence no. 7, *Mother sing.lullaby-sleep baby* (mother sings the baby to sleep), arguably has only one preferred interpretation pragmatically – mothers always sing babies to sleep but not the other way around. But note that it is also pragmatically plausible that this sentence could mean 'mother sings to the baby and mother falls asleep'. In other words, children need to understand that this type of RVC has only one correct interpretation, and it is the one in which the second argument is shared.

trials had three different orders, and no child watched the cartoon clips in the same order in each block. In each block there were also three easy control trials, which were used to give the child more confidence and to forestall a "yes" bias (two of the control items needed a "no" answer). Appendix 7.1 describes each cartoon clip and the control trials; cartoon clips that match the interpretation of the test sentences are labeled as *Target* and those that do not match are labeled as *Competitor* in Appendix 7.1.

Participants and procedure

Four groups of participants were tested: three groups of children with mean ages of 3;6 (age range 3;3 – 3;7), 4;7 (4;5 – 4;8), and 6;0 (5;7 – 6;1), and a group of adults (mean age 25). There were 10 participants in each group. The children came from two kindergartens in Guangzhou, P. R. China: Guangzhou Junjing Kindergarten and South China Normal University Kindergarten. The families and language backgrounds of these children are similar to those of the children in the previous experiments (see §4.4).

As discussed in Chapter 4, Mandarin children have typically learned the combinatorial nature of RVCs by as early as 2;6 years of age. But the Argument Structure Cartoon experiment was relatively difficult; pilot testing showed that it did not work well with children below three years old. So my youngest participants were three and a half years old.

The task was a truth value judgment task, adapted for children. The child watched the cartoon clips one by one, along with the experimenter and a puppet who was said to be silly. After each clip was played, the silly puppet described what had happened, using the test sentence for which the clip was a candidate illustration (see Table 7.2 for the test sentences). The child was asked to decide whether the puppet had described the event correctly, and, if so, to reward it by putting a piece of candy into its mouth (= a "yes" response), and, if not, to punish it by putting a small piece of junk paper into its mouth (= a "no" response).

7.3.2 Results

Figure 7.2 shows the percentage of "yes" responses by age group, summed across the two test sentences for each type of RVC. For RVCs types 1 to 4, there should be a low percentage of "yes" responses since only one interpretation (out of three) is correct (1/3 = 33%). For type 5, all three interpretations are correct (100%).

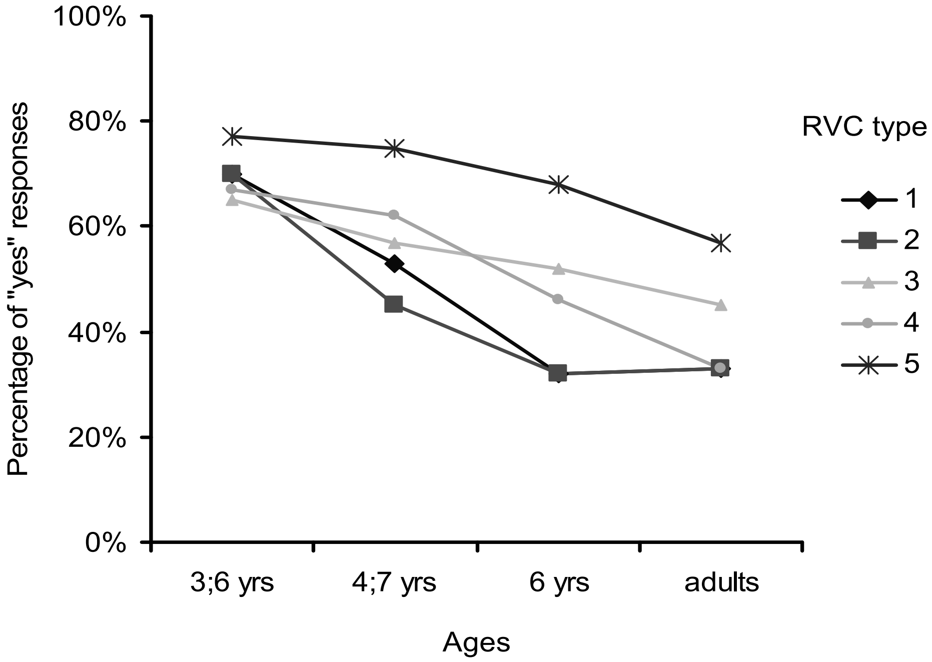


Figure 7.2. Percentage of "yes" responses by RVC type and age

On RVC types 1 to 4, the RVC types with unambiguous argument assignment patterns, the adults said "yes" only about 30% to 45% of the time, whereas the children said "yes" much more often. There is a developmental trend with increased age, with the oldest children – the 6-year-olds – responding very much like the adults. But on RVC type 5, which has multiple argument assignment patterns, all the children's groups seemed to perform "better" than the adult group, accepting more clips illustrating different candidate argument assignment patterns.

We will return to this puzzling finding in a moment. But first, let us determine whether the apparent differences by RVC type and by age are statistically significant. A suitable method is the CART analysis since our data set involves frequency counts of binary categorical dependent variables, i.e., "yes" and "no" responses. The CART analysis was introduced in Chapter 5 (§5.2.2) in a study of children's comprehension of RVCs. In the present chapter, I use it to determine whether either of the independent variables, *RVC type* and *age*, plays a significant role in predicting the dependent variable, *responses* ("yes" vs. "no" answers). The total number of responses was 1200 (= 4 age groups × 10 subjects × 30 trials each). The raw data of participants' responses for each trial were read into the R program (version 2.2.2), and the CART analysis generated the structural tree show in Figure 7.3.

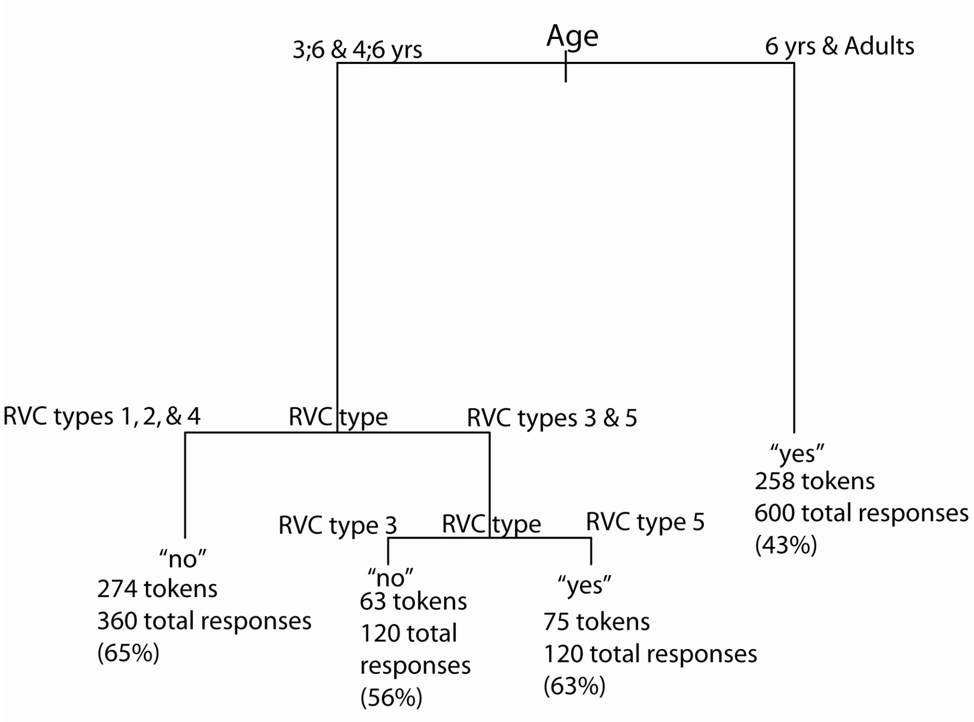


Figure 7.3. CART analysis of the responses to the sentences containing different types of RVCs, by age

At the top of each split is a label for the predictor variable responsible for the split, with the relevant level(s) of this predictor indicated on the two branches. The terminal nodes of all the branches are labeled according to the relevant level of the dependent variables ("yes" or "no" responses). Below each terminal node we see the raw number of responses falling under that level, along with the total number of responses and (in parentheses) the percentage this represents. For example, the total number of responses for the 6-year-olds and the adults (top right branch) is 600 (= 10 subjects × 2 age groups × 30 trials); of these there were 258 "yes" responses, which represent 43% of the total.

Figure 7.3 shows that the data are first divided into two large groups on the basis of *age*: a group of younger children (3;6- and 4;7-year-olds) vs. a group of older children (6-year-olds) and the adults. The data from the 3;6- and 4;7-year-olds are then further divided (the second split on the left) on the basis of the other independent variable, *RVC type*: types 1, 2, and 4 vs. types 3 and 5. The latter RVC-type groups are again further subdivided: type 3 vs. type 5 (the lowest split of the left branch).

Recall that the order of node-splitting indicates the relative importance of the predictor variables in determining the dependent variable. So the predictor variable *age*, shown at the first split node, is the primary predictor of the participants' responses, and *verb compound type,* shown at the second and the third split nodes, is the secondary predictor variable. This means that the youngest age groups, the 3;6- and the 4;7-year-olds, differ significantly from the 6-year-olds and the adults in giving more "yes" responses overall to all the verb compound types. In other words, only the oldest child age group, the 6-year-olds, resembled the adults in their overall proportions of “yes” and “no” responses. The two youngest age groups also responded differently to different types of verb compounds: types 3 and 5 attracted significantly more “yes” responses than types 1, 2, and 4 (indicated by the second split); and type 5 attracted more than type 3 (third split).

The CART analysis confirms that the two youngest age groups gave significantly more correct “yes” responses than the 6-year-olds and the adults to RVCs of type 5, for which all three cartoon depictions provide an acceptable interpretation. To unravel this puzzle, let us examine responses across the RVC types, broken down by age and cartoon clips, as shown in 7.4.

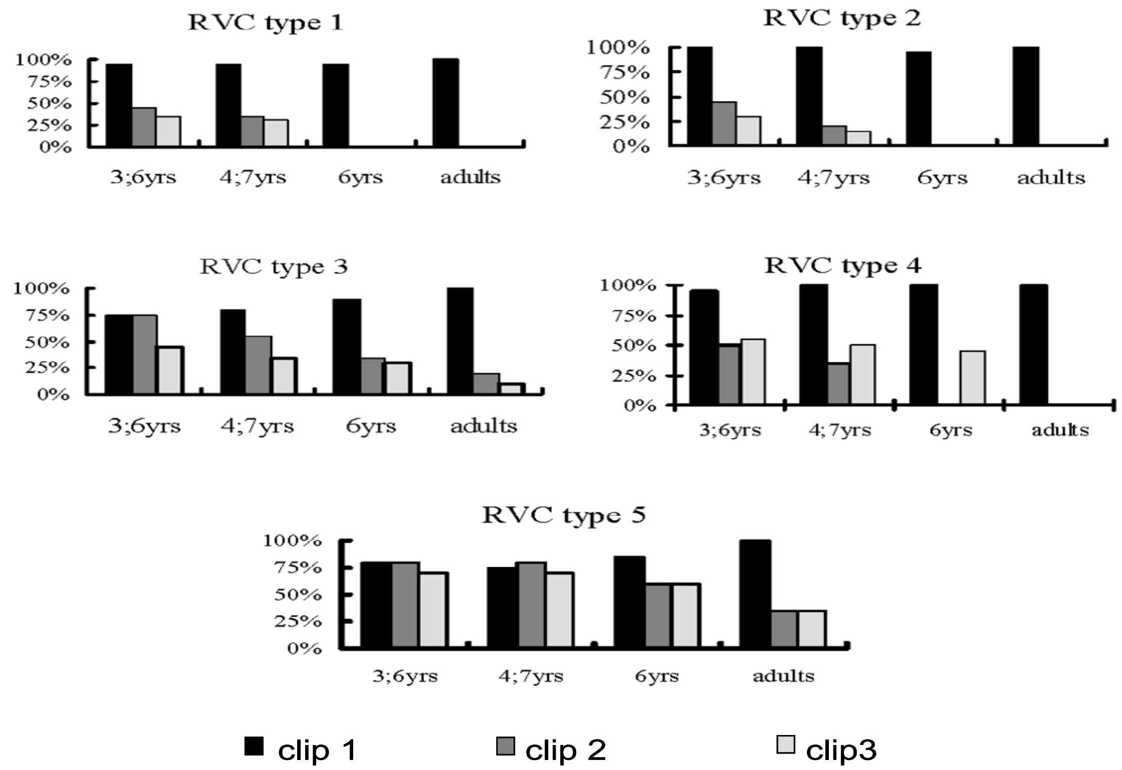


Figure 7.4. Percentages of “yes” responses by RVC type, age, and clips

Clip 1: Matching depiction of RVC types 1-5

Clips 2 & 3: Matching depictions for RVC type 5; Non-matching for RVC types 1-4

For RVC type 5, all three clips – black, dark grey, and light grey – correctly depict the test sentence. The adults accepted all the clips to a certain extent, which contrasts with their categorical rejection of the two mismatching cartoon clips for RVC types 1 to 4. Children of all ages accepted all the clips for RVC type 5 at a relatively high rate, and all three clips received a very similar percentage of “yes” responses, as indicated by the similar height of the black, dark grey, and light grey bars in Figure 7.4. This resulted in more apparent "correct" responses from the children than from the adults (see also Figure 7.2).

In fact, the children accepted more clips than the adults did for every RVC type in Figure 7.4 (the bars for the children are overall higher than those for the adults). Does this stem from an overall "yes" bias? This seems unlikely. No child gave only a "yes" (or only a "no") response to all test trials; recall also that the analysis includes only children who gave correct responses on all three control items, which required both "yes" and "no" answers. The children were clearly capable of discriminating between clips they deemed to match the test sentences and those they did not, and their pattern of discrimination was, in broad outline, like that of adults. But on RVC types 1 to 4, the adults showed a clear preference for a single interpretation, while the children in general accepted more interpretations.

Children's higher level of "correct" responding on RVC type 5 is probably in part a byproduct of their tendency to accept more interpretations in general. But even though the children were overall more lenient than the adults, their treatment of RVC type 5 stands out: they gave many more "yes" responses to all three interpretations of RVC type 5 than to the other four RVC types. Possibly, then, they had already gotten some feel for the fact that RVC type 5 allows multiple interpretations. In sum, the analysis suggests that children have not yet fully learned the rules underlying argument assignment for transitive RVCs, even though, as Figure 7.4 shows, they in general favor the same interpretations as the adults.

But why did the adults not unanimously accept the multiple interpretations that, according to the literature and the informal intuitions of several native speakers, are possible for RVC type 5? One speculative answer is that some of the interpretations may be harder to retrieve than others, especially on a task where an immediate judgment is required. Consistent with this, Y.-F. Li (1995) noted that some readings of RVCs with multiple possible argument assignments are harder for native speakers to obtain than others. Another explanation is that there is simply variation in grammatical judgments for RVC type 5: certain interpretations are perhaps acceptable to some people, but not to others.

7.4 Conclusions

This chapter has investigated how Mandarin speakers of different ages interpret sentences containing an RVC with two animate arguments. The argument assignment patterns of RVCs are systematic, based on the transitivity of the component verbs. Five types of RVCs with distinct argument assignment patterns were tested in a truth-value judgment task. Participants interpreted the sentences differently according to RVC type. On RVC types with an unambiguous argument assignment pattern (types 1 to 4), the children favored the adult interpretation from the beginning but often accepted the two other interpretations as well; these erroneous acceptances decreased with age. On the RVC type with multiple argument assignment patterns (type 5), children seemed to be more "correct" than adults: they were significantly more likely to accept multiple cartoon depictions that, according to the literature and the intuitions of several native speakers, all show possible interpretations (see Figure 7.2). Children's seemingly superior knowledge of type 5 RVCs may have simply reflected their overall tendency to accept more argument assignment interpretations for clips of all types than adults did, as well as, perhaps, as a feel for the multiple argument-structure mapping possibilities of this type of RVC.

This study has implications for the study of productivity in children's acquisition of verb argument structure. Previous research on this topic has focused on how children learn the argument structures and permissible alternation patterns of simplex verbs (e.g., Gleitman, 1990; Goldberg, Casenhiser, & Sethuraman, 2004; Pinker, 1989; Tomasello, 1992). No studies have explored the acquisition of the argument structure of complex predicates like Mandarin RVCs. These predicates present special learning problems: to become productive, children must go beyond the argument structure of the component verbs, taken one at a time, and determine the adult-like way to combine them into a single higher-order transitive argument structure.

The experimental data seem to fit well with a constructivist view of language learning. This approach postulates that language involves a gradual and somewhat piecemeal learning process in which some constructions are mastered before others, with differences often due to the amount and nature of the relevant linguistic input that children receive (e.g., Goldberg, 1995; Goldberg, Casenhiser, & Sethuraman, 2004; Tomasello, 1992, 2000b). Recall that from an early age, children go for the interpretation of an RVC that adults also favor, but they are more liberal, also accepting, although to a lesser extent, interpretations that adults reject. Over time they become more particular, increasingly accepting only the correct adult argument mapping patterns. This learning pattern suggests that children construct and refine argument assignment patterns over time, extracting schemas from the input early on, but only later refining them and coming to a fully adult-like grasp of the constraints imposed by the transitivity of the component verbs.

SUMMARY AND CONCLUSIONS

CHAPTER 8

8.1 Introduction

In this dissertation I have examined children's acquisition of verb compounding in Mandarin Chinese. Verb compounding is a very productive process in Mandarin, with fluent speakers able to create novel verb compounds (VCs) as needed for encoding new situations. My focus has been on two types of verb compounds that constitute the most typical way to encode events of motion and state change in Mandarin: directional verb compounds (DVCs) (e.g., *zou3-jin4* 'walk-enter' [= walk in]) and resultative verb compounds (RVCs) (e.g., *ca1-gan1jing4* 'wipe-be.clean' [= wipe clean]).

The acquisition of verb compounding in Mandarin is of interest for the broader study of language acquisition for several reasons. First, although the compounding process is productive, it is constrained in various ways, and not all conceivable verb compounds (VCs) are possible. How children learn partially productive processes has in recent years been a controversial topic over which alternative theories of language acquisition have clashed; in particular, nativist approaches that invoke innate knowledge have been challenged by constructional, usage-based approaches that stress learning from the linguistic input. Second, verb compounding in Mandarin represents a systematic language-specific solution to problems that every languages shares: how to select, categorize, and combine – in short, "package" – information in communicating about everyday events and situations. By concentrating on this grammatical domain and comparing findings to what we know about acquisition in other languages, we can determine when and to what extent learners show sensitivity to language-specific categories and patterns.

To explore these issues, I first analyzed the lexical and semantic properties of verb compounds, and contrasted them with other related constructions. I then investigated longitudinal corpora of the spontaneous speech of Mandarin-speaking children and their caregivers, and conducted a number of experiments designed to elicit VCs or tap children's understanding of their structure. In this final chapter, I summarize my findings and conclusions, and consider their implications for our theoretical understanding of how children achieve productivity in the acquisition of the grammatical constructions of their language.

8.2 Summary of the main findings

8.2.1 Stage setting

Chapters 2 and 3 set the stage for my investigation of children's acquisition of Mandarin verb compounding. In Chapter 2, I presented the linguistic features of Mandarin DVCs and RVCs, and laid out typological features of how these constructions lexicalize events of motion and state change. In this context I discussed recent studies that use Mandarin DVCs to challenge Talmy's (1985, 2000) dichotomy between verb-framed languages and satellite-framed languages, and to argue for a third type of language proposed by Slobin (2004), "equipollently-framed languages".

I then explained in detail the composition of DVCs and RVCs, and discussed their productivity. The productivity of these compounds is very high: novel but acceptable VCs can be flexibly created on the spot to fit new situations, and the verb combinations can specify a variety of semantic relations, including unexpected or conflicting outcomes (e.g., *xi13-zang1* 'wash-be.dirty). But this productivity is by no means without limits. In an effort to identify the restrictions and characterize what children must learn, I proposed a number of morphological and semantic constraints on the formation of VCs.

In Chapter 3, theoretical issues of productivity in language acquisition were reviewed, along with existing crosslinguistic studies of the acquisition of complex predicates that encode motion and state-change events. These discussions identified the usage-based approach to language as the general theoretical framework for my own work, and provided us with an empirical jumping-off point.

8.2.2 Producing verb compounds

Chapter 4 addressed the general developmental trajectory followed by children in learning to produce VCs, with an emphasis on whether and when they know about the combinatorial nature of these constructions. In the first part of the chapter I analyzed the spontaneous speech from two longitudinal corpora of children and their caregivers. Development is gradual. VCs appear in children's speech at around age 1;4 to 1;7, but tokens are few below about age 2;2 and they do not show much productivity; for example, most combinations also appear in the adult input to the children. Flexibility increases slowly, with children beginning to show a grasp of the combinatorial nature of VCs from about 2;6 on: by this time they use the constituent verbs alone as well as in compounds, they know which slot each verb goes in and never make ordering errors, they produce VCs showing a number of different semantic relations between the component verbs, and – most revealing – they produce outright errors: e.g., combinations with too many component verbs, or with verbs that are unacceptable to adults in the V_1 or V_2 slot.

In the second part of Chapter 4, I presented three experiments that examined children's productivity with DVCs and RVCs in a more controlled way. Experiment 1, the *Tomato Man* elicitation, investigated how productive children are in using DVCs to describe new motion events. The results showed that already by 2;6 children produce just as many types and tokens of DVCs as older children. Early productivity is also revealed by unconventional innovative DVCs, such as *dong4-shang4-qu4* 'dong-ascend-go' [= go up in a "donging" manner], in which the first element is not a verb, but an onomatopoetic word capturing the sound of jumping.

Experiment 2, the *Kids' Cut and Break* study, explored how productive children are in using RVCs to describe state-change events in the specific semantic domain of cutting and breaking (C&B, for short). As in Experiment 1, children were found to be quite productive from 2;6 on, as is indicated by the many types and tokens of RVCs in their descriptions of C&B events. A given V_2 was often combined with a variety of V_1s and vice versa (e.g., *bai1-**duan4*** 'bend-be.broken crosswise', *qie1-**duan4*** 'cut with a single-bladed instrument-be.broken crosswise', *jian3-**duan4*** 'cut with a double-bladed instrument-be.broken crosswise'). Innovative and odd-sounding RVCs were also observed, e.g., **che3-bai1* 'pull-bend' (describing cutting spring onions by pressing them against a static knife).

Experiment 3, the *VC Constraints* study, explored children's knowledge of constraints on the productivity of verb compounding in Mandarin. This experiment elicited descriptions of video clips, as well as soliciting judgments from learners about whether a given VC could be used to describe a clip. The probes comprised both conventional VCs and VCs that adults consider unacceptable. Up to age 6;1, the children still tended to accept most of the odd VCs; only by around 8;1 did they begin to acquire a feel for disallowed combinations. This study suggests that learning the constraints of verb compounding is a gradual process and may take many years after basic productivity has been established.

Taken together, these findings show that children use varied VCs frequently and productively from at least 2;6, suggesting that they have become sensitive to the Mandarin-specific method of packaging events at a very young age. In particular, they seem to grasp the characteristic use of verb compounding to encode a whole motion or state-change event in two parts, with each verb specifying only one aspect of the event. Establishing a feel for restrictions on combinations – e.g., how many verbs can be combined and what semantic classes these verbs must belong to – develops much more slowly.

8.2.3 Where is state change encoded in RVCs?

In addition to learning about general constraints on verb compounding, children must learn about the more specific semantics of these constructions. I focused on learners' understanding of two aspects of the meaning of transitive RVCs: (1) the schematic meaning of the RVC as a whole – the expression of state change – and where exactly this meaning is encoded (Chapter 5); and (2) the fine-grained semantics of the two verbs in RVCs encoding events in a specific semantic domain, that of "cutting and breaking" (Chapter 6).

Transitive RVCs typically encode a caused state change: someone does something (V_1), which brings about change of state in a patient (V_2). In English translation, the V_1 would often seem to inherently entail a state change (e.g., 'break', 'close', 'kill'), but in Mandarin the verb is agnostic about a state change, or at best only pragmatically implicates it. To confirm that a state change actually came about as a result of the action specified by $V_{1,}$ the speaker must add a V_2 such as 'be.in.pieces', 'be.closed' or 'be.dead'. To determine what learners of Mandarin know about this two-part schema – in particular, what they know about the meaning of the RVC as a whole, and what they know about the specific contribution of V_1, I conducted Experiment 4, the *State-change* experiment.

Previous research has shown that learners of English and German have difficulty learning that causative-transitive verbs such as *break* and *mix* entail a state change (Erkelens, 2003). At best, they tend to think that the verb specifies a particular action that might typically lead to the state change (the "manner" bias, Gentner, 1978; or the "weak-end-state" hypothesis, Wittek, 1999, 2002). The "manner" bias has been thought perhaps to reflect a universal perceptual predisposition. But children learning Mandarin do not show this misinterpretation: already by as young as 2;6 they realize that an RVC as a whole entails a state change. When we zoom in on children's interpretation of the V_1 of an RVC, however, we discovered an intriguing misconception: in striking contrast to learners of English and German, who fail to grasp that verbs like 'break' and 'kill' entail a state change, learners of Mandarin fail to grasp that such verb do *not* entail a state change – that is, they incorrectly treat V_1s as if these verbs – just like the RVC as a whole – *do* entail a state change!

The manner bias is not, then, universal; the learning problems that children must solve in this domain are linked to the structure of the input language. But children's misattribution of a state-change meaning to V_1 is not uniformly strong across all V_1s. The verbs that children are most likely to treat incorrectly as entailing a state change are those that, for adults, indeed have a relatively strong – although still defeasible – state-change implicature (such as *guan1* 'do a closing action'). Verbs that for adults have a weaker state-change implicature (e.g., *chui2* 'to hammer') children tend to treat correctly as entailing only an action. This study is the first to show that children are remarkably sensitive to subtle differences in the strength of a verb's state-change implicature.

8.2.4 Learning the semantics of cutting and breaking verbs

Children's grasp of the fine-grained semantics of the two verbs in RVCs, and what they contribute to the RVC as a whole, is the topic of Chapter 6. Here I examined how learners approach this acquisitional task by comparing how children of different ages, and adults, use V_1s (action verbs) and V_2s (result verbs) in elicited descriptions of events of "cutting and breaking".

In Chapter 4, we saw that children use C&B action verbs and result verbs separately, as well as combined in RVCs, from as young as 2;6 years. In examining now exactly how these verbs were applied, we see that these very young children are also remarkably accurate in approximating the adult verb categories encoded in the V_1s (the action verbs), observing even Mandarin-specific distinctions like 'cut with a single-bladed instrument' vs. 'cut with a double-bladed instrument' relatively well. But they do not weight the semantic features of the V_1s exactly as adults do, and they are still adjusting event category boundaries even when they are as old as 6 years. This outcome is similar to results obtained by Erkelens (2003) for somewhat older Dutch children who described the same set of C&B stimuli that I have used and by Bowerman and Choi (2001) for two-year-old learners of English and Korean, from whom they had elicited descriptions of a set of actions of joining and separating objects. Children are evidently capable of homing in remarkably early on language-specific ways of categorizing events.

The V_2s of RVCs (the result verbs) give learners of Mandarin more problems than the V_1s (the action verbs). Learners do show some knowledge of these verbs' semantic features, and their result subevent categories approximate those of adults. But it takes them longer to fully establish which properties of an affected object are critical for selecting a C&B result verb than to determine which properties of an action are critical for selecting an action verb. In general, Mandarin learners tend to prefer rather general result verbs over the more specific one that adults choose; for example, they use *kai1* 'be open, apart' more frequently than adults, and *duan4* 'be broken crosswise (of linear object)' less frequently. Why the meanings of Mandarin result verbs are more difficult than those of action verbs for language learners is a question that must be left to future research.

8.2.5 Learning the argument structure of verb compounds

VCs are complex not only in their semantic composition but also in their syntax. In particular, their argument structure is built up in only partially predictable ways out of the argument structures of their component verbs. In Chapter 7, I examined a subgroup of VCs, namely, transitive RVCs. On the basis of the transitivity of their component verbs, RVCs can be divided into five subcategories with distinct argument mapping patterns. Four types allow only one argument-mapping pattern; whereas a fifth type is compatible with several patterns. To determine when and how children figure out these mapping patterns, I carried out Experiment 5, the *Argument Structure Cartoon* study.

This study shows that children can interpret the argument assignment patterns of RVCs systematically from a young age. By at least 3;6 – the youngest age that could be tested – learners of Mandarin assign different argument structures to different types of RVCs, and clearly prefer the interpretations that adults also favor; over time, they also increasingly reject the interpretations that adults reject. Despite this early skill, they have not yet even by as much as a year later fully mastered the way argument-sharing patterns are affected by the transitivity of the component verbs and the semantics of the second verb of an RVC.

8.3 Theoretical implications

8.3.1 Usage-based approach to learning grammatical constructions

The developmental patterns I have just described support the usage-based approach to language acquisition. This approach characterizes language acquisition as an inductive process that that takes place gradually over time, that is closely influenced by properties of the language input such as the relative frequency of different forms, and that is subject to errors as children overgeneralize frequent patterns before gradually fine-tuning them on the basis of further experience (see §3.4.3). The usage-based approach contrasts with nativist approaches, which envision a more error-free learning process assisted by innate knowledge of principles and parameters, or by universal patterns of argument linking and of the semantics components defining relevant semantic subclasses of verbs (see §3.4.1 and §3.4.2).

In line with the usage-based approach, the spontaneous speech data show a gradual development based closely on the input. In the early stages of producing verb compounds, learners of Mandarin use a very limited number of types and tokens of VCs, and their initial VCs form subsets of the high-frequency VCs modeled in the input. By around 2;6 children have apparently analyzed VCs into their component verbs, and they begin to create novel compounds. Initially their productivity revolves around pivot-like constructions in which the verb in one slot (either V_1 or V_2) is held constant while a variety of verbs is rotated through the other slot. Later they work up to a more abstract and schematic knowledge of which kinds of verbs (e.g., manner verbs, Path verbs, deictic verbs, result verbs) occur in each slot. But now their productivity goes too far: as shown by both the spontaneous speech data and by my various experimental studies, children create and accept novel compounds that adults find strange and unacceptable, and their knowledge of the semantics of VCs (e.g., where the state-change meaning is located in an RVC) is not yet complete. This developmental sequence is expected under the hypothesis shows that children build up abstract linguistic schemas in an extended constructional process. Learning the subtle constraints on schemas can take years.

According to the usage-based approach, children develop representations of grammatical categories by analyzing and gradually systematizing the distributional patterns observed in the input. This hypothesis assumes a close correspondence between patterns in the input and patterns in the output. In the spontaneous speech of the two corpora I analyzed, there was indeed a close correspondence: the children and the adults produced the different types of VCs with the same relative frequencies. The input clearly plays an important role in shaping the kinds of VC that children produce.

The usage-based approach predicts that children are sensitive not only to the distribution of specific forms in the input but also to the more abstract notion of which constructional schemas are more productive in adult speech: in particular, they acquire more productive schemas before less productive schemas (Clark, 1993). Both the spontaneous speech data and the various experiments show that adults rely heavily on DVCs and RVCs to describe motion events and state-change events. These are very productive constructions in adult grammar, and from an early age children also home in on these compounds as the strategies of choice for encoding novel events of motion and state change.

Children's persistent and systematic overgeneralizations in verb compounding also reveal something about the learning procedures applied to the acquisition of a construction. In the usage-based learning approach, overgeneralization errors are to be expected whenever there is a general pattern but this pattern is subject to idiosyncratic exceptions and/or subtle semantic or morphological constraints. Mandarin children's errors indicate that by a certain point they have indeed analyzed the composite nature of the verb compounds and extracted an abstract formal template $V_1V_2(V_3)$ associated with a semantic representation of spontaneous or caused location change (DVCs) or caused state change (RVCs), and they can apply this template to events they have not encountered previously. In this process they produce errors, e.g., they sometimes combine too many verbs (although they respect constraints on verb ordering), and they violate constraints on the semantic classes of verbs allowed in the verb slots.

8.3.2 Language specificity in learning to encode and categorize events

The data reported in this dissertation also shed light on the interaction between language acquisition and children's conceptualization of events. The basic findings from Chapters 4 and 6 suggest that language shapes the way that children attend to events, at least when they are talking about them, from as early as 2;6 years. This is the kind of effect that Slobin (1996) has termed "thinking for speaking": in the course of language acquisition, speakers come to conceptualize referent events and relationships in a way that is congruent with the characteristic encoding patterns of the language they are exposed to. For example, in the semantic domain of "cutting and breaking" events, children use both C&B action verbs and result verbs separately (e.g., *jian3* 'cut with a double-bladed instrument', *kai1* 'be open, apart'), and combine them increasingly often in an RVC (e.g., *jian3-kai1* 'cut with a single-bladed instrument-be apart'). The Mandarin technique of analyzing causal events into separate action and result components, each associated with its own type of verb, is thus learned very early. The Tomato Man study shows a similar pattern for motion events: children learn very early to analyze complex motions involving the displacement of a figure into a manner component and a Path component (either trajectory Path, deictic Path, or both).

Further evidence of learning to "think for speaking" is that in the domain of "cutting and breaking" events, children also become sensitive very early to the specific semantic distinctions that are important for Mandarin. For example, they use the "knife" verb *qie1* and especially the "scissor" verb *jian3* relatively correctly from 2;6 on, reflecting the obligatory Mandarin distinction between "single-bladed cutting" and "double-bladed cutting". This sensitivity is also observed in learners of Dutch, which makes the same obligatory distinction (Erkelens, 2003), but not in learners of languages with a unified "cutting" verb, such as English (Bowerman, 2005; Bowerman et al., 2004; Schaefer, 1979).

The effect on children of learning a language-specific semantic system is also seen in their interpretations of the state-change meaning in RVCs (Chapter 5). Learners of Mandarin must master a language-specific division of labor between the action verb (V_1) and the result verb (V_2) of an RVC: the RVC as a whole entails a state-change meaning, but this meaning comes from the construction as a whole. The action verb, especially when it is glossed as 'cut', 'break', 'kill', and the like, may imply a state change, but it does not entail it; and the result verb in itself specifies only a state, and not necessarily a state change. Learners of Mandarin seem to acquire the entailed state-change meaning of RVCs by as young as 2;6, but this mastery is only superficial: they do not yet understand that although the RVC as a whole entails a state change, the V_1 alone does not. This pattern of learning pattern contrasts strikingly with that of children learning English and German. Whereas learners of Mandarin wrongly think that a state-change meaning is entailed when it is *not*, learners of English and German *fail* to realize that a state-change meaning is entailed when it *is*! Different languages thus pose different semantic puzzles for learners, which causes children to diverge early on in their learning patterns.

8.4 Conclusions

The core problem to which this dissertation has been addressed is the acquisition of verb compounding in Mandarin. Although verb compounds have long been one of the central issues in theoretical approaches to Chinese linguistics, the acquisition of this grammatical system has never been systematically studied; this dissertation constitutes the first in-depth exploration of this topic.

In addition to contributing to our understanding of the acquisition of Mandarin, the dissertation also aims to provide insights into our more general understanding of how productivity develops in the course of language acquisition. In particular, it asks how children become productive with the strategies characteristically used by speakers of their language in mapping between forms and meanings, and what the learning process says about the general nature of language acquisition. The findings support a usage-based approach to language learning, according to which productivity develops gradually under the close influence of properties of the speech children hear; in particular, subtle constraints on productivity take children a long time to master.

The findings also contribute to our understanding of the relationship between language acquisition and children's nonlinguistic construal of events. In particular, they support and extend recent evidence that in learning to talk, children do not simply map the forms and constructions of their target language directly onto basic cognitive concepts of events. From the beginning, language learners are working out not only the grammatical structures of their language, but also the semantic structures – the meanings associated with words and with specific construction patterns. By allowing researchers to disentangle what is universal in the learning of language from what is specific to learners of individual languages, or languages of certain types, crosslinguistic work like the present study can help us to further delineate how nonlinguistic cognition and the structure of the linguistic input work together to help children build up knowledge of a specific language.

APPENDICES

Appendix 4.1. Mean length of utterance of the five children in the Fang corpus, by session

CHILD 1: MDY (Mengmeng)

AGE	NO. OF U.	MOR.	MLU	SD
1;3.15	180	240	1.333	0.587
1;4. 6	128	206	1.609	1.070
1;5.30	164	345	2.104	1.135
1;7.9	209	415	1.986	1.2000
1;10.13	82	228	2.780	1.675
1;11.12	91	118	2.066	1.184
2;0.0	243	722	2.971	1.797
2;1.13	119	366	3.076	1.450
2;2.27	91	246	2.703	1.866
2;3.6	143	506	3.538	1.928
2;7.3	58	169	2.914	1.764
3;0.5	219	732	3.342	2.571
3;1.10	122	468	3.836	2.559
3;2.3	135	551	4.081	1.951
3;3.4	330	1368	4.145	2.377
3;4.15	331	1492	4.508	2.733

CHILD 2: DAN (Dandan)

AGE	NO. OF U.	MOR.	MLU	SD
1;3.4	122	174	1.426	1.108
1;4.16	104	185	1.779	1.152
1;7.25	197	361	1.832	0.949
1;8.10	125	228	1.824	0.964
1;8.24	125	243	1.944	1.006
1;9.10`	83	154	1.855	0.996
1;9.25	177	342	1.932	1.103
1;10.8	297	703	2.367	1.776
1;10.22	227	628	2.309	1.500

CHILD 3: MLI (Maliang)

AGE	NO. OF U.	MOR.	MLU	SD
1;8.13	176	367	2.097	0.946
1;8.26	135	245	1.960	0.880
1;9.11	89	228	2.562	1.161
1;10.10	116	273	2.353	1.302
1;10.28	23	45	1.957	0.751
1;11.13	84	187	2.226	1.199
2;0.4	49	125	2.551	1.310
2;0.20	93	217	2.333	1.081
2;2;10	29	94	3.241	1.072

CHILD 4: LIA (Duanlian)

AGE	NO. OF U.	MOR.	MLU	SD
3;1.20	95	315	3.316	1.865
3;2.4	224	896	4.000	2.407
3;2.18	119	434	3.647	2.281
3;3.1	184	689	3.745	2.143
3;3.15	72	248	3.444	2.088
3;3.28	468	2140	4.573	2.397
3;4.12	266	985	3.703	2.461
3;4.27	282	1109	3.933	2.263
3;5.4	87	372	4.276	2.835

CHILD 5: JIA (Jiajia)

AGE	NO. OF U.	MOR.	MLU	SD
2;6.8	167	506	3.030	1.769
2;6.22	302	1110	3.675	2.088
2;7.0	249	705	2.831	1.725
2;7.19	270	1135	4.204	2.439
2;8.3	231	851	3.684	1.828
2;8.17	379	1582	4.174	2.098
2;9.11	368	1245	3.383	1.734
2;10.5	308	1120	3.636	2.087
2;10.13	334	1171	3.506	1.911

Appendix 4.2. Mean length of utterances of the ten children in the Beijing corpora, by session

CHI File	NO. OF U.	MOR.	MLU	SD
bb1 (1;10.12)	506	1197	2.366	1.683
bb2	536	918	1.713	0.981
bb3	622	1606	2.582	1.465
bb4	334	795	2.380	1.417
bb5 (2;2.7)	852	2667	3.130	1.707
cx1 (1;9.25)	456	902	1.978	1.431
cx2	449	743	1.655	0.950
cx3	489	864	1.767	0.980
cx4	680	1198	1.762	0.998
cx5 (2;1.18)	542	1118	2.063	1.136
hy1 (1;9.10)	1015	2324	2.290	1.208
hy2	682	1742	2.554	1.339
hy3	994	2130	2.143	1.183
hy4	585	1185	2.026	1.122
hy6 (2;1.4)	505	1628	3.224	1.478
lc1 (1;9.21)	736	1273	1.730	0.878
lc2	643	1176	1.829	1.189
lc3	692	1367	1.975	1.211
lc4	701	1668	2.379	1.399
lc5 (2;1.9)	547	1602	2.929	1.549
ll1 ((1;9.6)	522	1143	2.190	1.147
ll3	758	2022	2.668	1.828
ll4	663	2027	3.057	2.051
ll5 (2;0.27)	390	1060	2.718	1.565
lxb1 (1;9.3)	392	1042	2.658	1.612
lxb2	141	304	2.156	1.268
lxb23	519	1073	2.067	1.187
lxb3	674	1601	2.375	1.347
lxb4	325	843	2.594	1.747
lxb6 (2;1.9)	395	1097	2.777	1.617
tt1 (1;9.3)	297	604	2.034	1.230
tt2	459	873	1.902	1.506
tt3	492	1009	2.051	1.418
tt4	572	939	1.642	1.029
tt5 (2;0.28)	581	1121	1.929	1.190
ww1 (1;10.28	354	1035	2.924	1.565
ww2	487	1340	2.752	1.657
ww3	383	1407	3.674	3.022
ww4	326	877	2.690	1.562
ww6 (2;3.2)	439	1232	2.806	2.806
wx1 (1;9.27)	318	846	2.660	1.491
wx2	580	1459	2.516	1.621
wx3	559	1605	2.871	1.732
wx4	643	2098	3.263	1.852

wx5 (2;1.20)	887	3089	3.483	2.139
yy1 (1;10.20)	308	915	2.971	1.413
yy2	414	1078	2.604	1.759
yy3	365	834	2.285	1.610
yy4	614	1606	2.616	2.097
yy6 (2;2.18)	588	1864	3.170	2.098

Appendix 5.1. Events tested in the State-change experiment
Descriptions of the scenes used in the experiment that tested children's interpretation of the RVCs and their V_1s.

Test items	Description of the scene
1. 'close door'	STATE-CHANGE CONDITION The heavy door of an iron closet stands open. A woman comes in and gives the door a forceful push. The door closes. NO-STATE-CHANGE CONDITION The heavy door of an iron closet stands open. A woman comes in and gives the door a forceful push. The door does not close; it moves back and forth a bit.
2. 'crack nut'	STATE-CHANGE CONDITION Several walnuts and a nutcracker are lying on a table. A woman picks up the nutcracker, puts one of the nuts into it, and presses its two ends together. The nut cracks open. NO-STATE-CHANGE CONDITION Several walnuts and a nutcracker are lying on a table. A woman picks up the nutcracker, puts one of the nuts into it, and presses its two ends together. But the nut does not crack open and slips out of the nutcracker instead.
3. 'pick apple'	STATE-CHANGE CONDITION A woman stands next to a tree with an apple hanging on one of its twigs. She reaches out for the apple and pulls it towards her. The apple comes off the tree. NO-STATE-CHANGE CONDITION T A woman stands next to a tree with an apple hanging on one of its twigs. She reaches for the apple and pulls it towards her, but the apple does not come off the tree.
4. 'extinguish candle'	STATE-CHANGE CONDTION Three burning candles are standing on a table. A woman blows at one of them, and it goes out. NO-STATE-CHANGE CONDTION Three burning candles are standing on a table. A woman blows at one of them, but it does not go out; its flame only flickers a bit.
5. 'fill glass'	STATE-CHANGE CONDITION Three empty glasses and a pitcher with orange juice are standing on a black box on a table. A woman picks up the pitcher and pours juice into one of the glasses. The glass becomes full. NO-STATE-CHANGE CONDITION Three empty glasses and a pitcher with orange juice are standing on a black box on a table. A woman picks up the pitcher and pours juice into one of the glasses. But the glass does not become full (the liquid disappears into the black box through an invisible hole in the bottom of the glass).
6. 'kill animal'	STATE-CHANGE CONDITION An animal (a male actor wearing a deer mask) is attacking a woman. The woman takes a toy gun out of her pocket and

	shoots the animal. The animal falls onto the floor, apparently dead. NO-STATE-CHANGE CONDITION An animal (a male actor wearing a deer mask) is attacking a woman. The woman takes a toy gun out of her pocket and shoots the animal. But the animal does not fall onto the floor and keeps attacking her instead.
7. 'wake man'	STATE-CHANGE CONDITION A man is sleeping at a table. A woman comes in and holds a ringing alarm clock next to his head. The man wakes up. NO-STATE-CHANGE CONDITION A man is sleeping at a table. The woman comes in and holds a ringing alarm clock next to his head. But he does not wake up and keeps snoring instead.
8. 'break plate'	STATE-CHANGE CONDITION Several stacked-up plates and a hammer are lying on a table. A woman picks up the hammer and one of the plates, and hits the plate once with the hammer. The plate breaks. NO-STATE-CHANGE CONDITION Several stacked-up plates and a hammer are lying on a table. A woman picks up the hammer and one of the plates, and hits the plate once with the hammer. But the plate does not break.
Control items	
"Yes" answer called for	
1. 'turn chair'	A chair is in the middle of the room, with a woman standing behind it. The woman picks up the chair and turns it around twice. Then she puts it back down on the ground in its original position.
2. 'push car'	A toy truck is standing on a table. A woman pushes it back and forth. In the end, she places the truck in its original spot.
"No" answer called for	
1. 'wash car'	Two toy dump trucks are standing on a table. The truck bed of one of the trucks is lying next to it. A woman puts the truck bed onto the truck, using a spanner. In the end, the truck is repaired.
2. 'climb into closet'	The heavy door of an iron closet stands open. A woman comes in and looks into the closet.
Warm-up items	
"Yes" answer called for	
1. Fold paper	A piece of paper and a pair of scissors are lying on a table. The woman takes the scissors and cuts the paper.
"No" answer called for	
2. 'clean table'	Several pieces of broken glass and a cloth are lying on a table. A dustbin is standing next to the table. The woman takes the cloth and wipes the glass splinters into the dustbin.

Appendix 6.1. Token frequencies of C&B action verbs, by age and stimulus

(To facilitate reading, columns for *qie1* and *si1* are shaded.)

Verbs	***qie1***					***jian3***					***si1***					***bai1***				
Age / S t m l	2;6	3;6	4;6	6;1	A	2;6	3;6	4;6	6;1	A	2;6	3;6	4;6	6;1	A	2;6	3;6	4;6	6;1	A
1	1	0	0	0	0	9	10	10	10	10	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	4	4	6	2	3
3	10	9	9	10	10	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
4	1	1	2	1	1	0	1	0	0	0	7	4	6	8	5	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0	0	10	6	7	6	7	0	0	2	0	0
6	0	0	0	0	0	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0	0	0	1	0	1	0	5	5	9	3	7
8	8	6	7	9	8	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
9	2	1	0	5	9	0	0	1	0	0	0	0	0	0	0	1	1	0	0	0
10	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	9	5	2	3	2	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
12	1	2	0	0	1	7	5	4	6	2	0	0	0	0	0	0	0	0	0	0
13	9	9	9	10	9	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0
14	1	1	0	0	0	0	0	0	0	0	3	5	5	6	7	3	3	3	1	3
15	0	0	0	0	0	10	10	9	10	10	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	6	6	8	8	10	0	1	2	0	0
17	10	9	9	9	10	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	5	6	8	4	9
19	2	0	0	0	0	7	5	4	5	0	0	2	0	2	6	0	0	1	0	0
20	1	0	0	0	0	0	0	0	0	0	8	8	8	9	10	1	0	1	0	0
21	0	0	0	0	0	10	10	10	10	10	0	0	0	0	0	0	0	0	0	0
22	3	2	2	5	9	5	4	6	2	1	0	0	0	0	0	0	0	0	0	0
23	1	5	2	3	5	1	0	0	0	0	1	1	0	0	0	1	0	1	0	0
24	6	2	6	9	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
26	6	3	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
27	1	1	0	0	0	9	9	9	10	10	0	0	0	0	0	0	0	0	0	0
28	4	6	9	10	4	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Sum	77	63	57	74	71	74	65	64	63	53	35	34	34	43	45	20	21	34	10	22

A= Adults

jian3 ‘cut with a double-bladed instrument’
qie1 ‘cut with a single-bladed instrument’
si1 ‘tear, rip’
bai1 ‘bend’

Appendix 6.2. Token frequencies of C&B result verbs, by age and stimulus

(To facilitate reading, columns for *kai1*, *lan4*, and *xia-lai2* are shaded.)

Verbs	kai1					duan4					lan4					sui4					xia4lai2				
Age / Stim l	2;6	3;6	4;6	6;1	A	2;6	3;6	4;6	6;1	A	2;6	3;6	4;6	6;1	A	2;6	3;6	4;6	6;1	A	2;6	3;6	4;6	6;1	A
1	0	0	0	1	2	0	0	0	0	1	0	0	0	0	0	1	3	2	2	7	0	0	0	2	6
2	1	3	2	2	0	5	0	4	5	9	1	1	2	1	0	0	2	2	0	4	0	0	1	0	3
3	1	1	5	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1	0	1	3
4	1	0	4	3	4	1	0	0	0	3	0	0	2	2	0	0	1	0	0	0	0	0	2	1	3
5	1	1	3	0	1	0	0	1	0	1	1	3	0	5	1	1	0	0	0	0	0	0	0	0	3
6	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
7	2	3	7	6	3	1	0	0	1	1	2	0	0	0	0	0	0	1	0	0	0	0	1	1	2
8	1	2	3	1	3	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0	1
9	2	1	0	1	3	0	0	0	0	0	2	3	1	2	0	0	0	0	0	0	0	0	3	0	1
10	0	0	1	0	0	0	0	0	0	0	6	3	5	10	2	1	0	0	0	0	0	0	0	0	0
11	0	1	3	1	0	2	1	2	0	6	0	1	3	1	0	0	0	1	1	0	0	0	0	0	0
12	0	0	0	0	0	1	0	0	1	8	0	0	0	1	0	0	0	0	0	0	0	1	0	0	0
13	0	0	1	1	3	1	0	0	0	0	4	0	0	1	0	0	0	0	0	0	0	0	1	0	0
14	2	2	5	2	4	2	0	0	0	0	1	0	0	2	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	1	0	0	0	0
16	2	4	5	1	6	0	0	0	0	0	2	3	1	5	1	0	0	0	0	0	0	0	0	0	0
17	0	2	0	0	0	1	0	0	1	0	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0
18	2	4	6	3	5	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19	1	1	3	2	5	1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0
20	0	1	3	4	1	2	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	1	0	0
21	0	0	0	0	4	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
22	0	0	4	2	6	0	0	0	0	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	0
23	2	0	2	1	3	2	0	4	3	4	1	1	0	1	0	0	0	0	0	0	0	0	1	2	0
24	0	0	2	1	1	2	3	1	2	5	1	1	1	1	0	0	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0	0	7	7	4	6	1	0	0	0	0	0	0	0	0	0	0
26	0	1	2	0	1	4	0	2	4	6	2	2	1	4	0	0	0	0	0	0	0	0	0	0	0
27	1	1	0	0	1	0	0	0	0	5	0	0	0	1	0	0	0	0	0	0	0	0	0	2	0
28	1	1	4	1	2	4	2	1	1	7	1	2	1	3	0	0	0	0	0	0	0	0	1	0	0
sum	20	29	65	33	60	31	6	15	18	57	36	28	21	50	5	5	6	6	3	11	1	3	11	9	24

A = adults

duan4 ‘be broken crosswise (of linear object)’
kai1 ‘be open, apart’
lan4 ‘be smashed, in pieces, tattered, rotten’
sui4 ‘be smashed, in pieces’
xia4-lai2 ‘descend-come’ (come off)

Appendix 7.1. Descriptions of the cartoon clips illustrating the test sentences containing different types of RVCs in the *Argument Structure Cartoon* experiment (see Table 7.2 for test sentences).

Note: Each test sentence is associated with three different cartoon clips. For RVC types 1 to 4, only one clip correctly illustrates the meaning of the sentence. For RVCs of type 5, all three clips illustrate a possible meaning.

The test sentences are presented here in English translations for reading convenience; the RVCs are shown in bold. The clip labels in italics briefly describe what the clip shows; this is followed by a more complete description. The correct depictions are labeled "TARGET" and the incorrect ones "COMPETITOR".

Test sentence	Cartoon clips associated with the test sentences
RVC type 1: $V_{INT}V_{INT}$ (no sharing of arguments)	
1. Sister **cry-run** brother.	CLIP 1 (TARGET) *Sister cries and brother runs away.* A girl stands crying besides a boy, and as a result the boy runs away from the girl. CLIP 2 (COMPETITOR) *Sister cries and she runs away.* A girl stands crying besides a boy and then she runs away from the boy. CLIP 3 (COMPETITOR) *Brother cries and sister runs away.* A boy stands crying besides a girl and then the girl runs away.
2. Kitty **laugh-be.awake** doggie.	CLIP 1 (TARGET) *Kitty laughs and doggie wakes up.* Kitty and doggie are sleeping in two separate beds in a room. Kitty laughs in a dream and doggie wakes up. CLIP2 (COMPETITOR) *Kitty laughs and she wakes herself up.* Kitty and doggie are sleeping in two separate beds in a room. Kitty laughs in dream and she wakes herself up. (Doggie remains sleeping.) CLIP3 (COMPETITOR) *Doggie laughs and kitty wakes up.* Kitty and doggie are sleeping in two separate beds in a room. Doggie laughs in dream and wakes up kitty. (Doggie remains sleeping.)
RVC type 2: $V_{TR}V_{TR}$ (both arguments shared)	
3. Doggie **fight-win** kitty.	CLIP 1 (TARGET) *Doggie fights kitty and doggie wins.* Doggie is fighting kitty for a piece of cake. Doggie wins and gets the cake. CLIP2 (COMPETITOR)

Doggie fights kitty and kitty wins.
Doggie is fighting kitty for a piece of cake. Kitty wins and gets the cake.

CLIP3 (COMPETITOR)
Doggie fights kitty and they have a draw.
Doggie is fighting kitty for a piece of cake. The cake breaks into two pieces and each of them gets a half.

4. Wolf **bite-hurt** tiger.

CLIP 1 (TARGET)
Wolf bites tiger and wolf hurts tiger. (TARGET)
A wolf bites a tiger in the front leg and the tiger bleeds.

Wolf bites tiger and hurts himself. (COMPETITOR)
A wolf bites a tiger in the front leg, and the wolf's tooth breaks and he bleeds.

Tiger bites wolf and hurt himself. (COMPETITOR)
A tiger bites a wolf in the front leg, and the tiger's tooth breaks and he bleeds.

RVC type 3: $V_{INTR}V_{TR}$ (first argument shared)

5. Doggie **run-lose** kitty.

CLIP 1 (TARGET)
Doggie runs and doggie loses kitty.
Doggie and kitten run together. Doggie runs faster and she passes kitty. Kitty is left far behind and disappears off the screen; doggie runs alone.

CLIP2 (COMPETITOR)
Doggie runs and kitty loses doggie.
Doggie and kitten run together. Doggie runs faster than kitty. She runs too far ahead and disappears off the screen. Kitty runs on along on the screen.

CLIP3 (COMPETITOR)
Kitty runs and doggie loses kitty.
Doggie and kitten run together. Kitty runs faster than doggie. She runs too far ahead and disappears off the screen. Doggie runs alone on the screen.

6. Kitty **play-forget** doggie.

CLIP 1 (TARGET)
Kitty plays and forgets doggie.
Kitty and doggie have a dinner appointment. Kitty plays with butterflies on her way and she forgets doggie, who is waiting for her at the dinner table.

CLIP 2 (COMPETITOR)
Doggie plays and forgets kitty.
Kitty and doggie have a dinner appointment. Doggie plays with butterflies on her way and she forgets doggie, who is waiting at the dinner table.

CLIP 3 (COMPETITOR)

	Kitty and doggie play together and they forget (dinner). Kitty and doggie have a dinner appointment. Kitty and doggie play together (with butterflies) and they forget dinner, which is already on the dinner table.
RVC type 4: $V_{TR}V_{INTR}$: (second argument shared)	
7. Mother **sing.lullaby-sleep** baby.	CLIP 1 (TARGET) *Mother sings and baby falls asleep.* Mother sings to a baby in a cradle and baby falls asleep (baby's eyes change from open to closed). CLIP2 (COMPETITOR) *Mother sings and mother falls asleep.* Mother sings to a baby in a cradle and mother falls asleep (baby's eyes remain open). CLIP3 (COMPETITOR) *Mother sings and mother and baby falls asleep.* Mother sings to a baby in a cradle and both mother and baby fall asleep (both sets of eyes close and their heads droop).
8. Kitty **topple-fall** doggie.	CLIP 1 (TARGET) *Kitty topples doggie and doggie falls.* Kitty and doggie are in a boxing game. Kitty topples doggie and doggie falls on the ground. CLIP 2 (COMPETITOR) *Doggie topples kitty and kitty falls.* Kitty and dogging are in a boxing game. Doggie topples kitty and kitty falls on the ground. CLIP 3 (COMPETITOR) *Doggie and kitty both fall.* Kitty and dogging are in a boxing game. Both doggie and kitty fall on the ground.
RVC type 5: $V_{TR}V_{INTR}$: (multiple argument-mapping patterns)	
9. Doggie **chase-be.tired** kitty.	CLIP 1 (TARGET) *Doggie chases kitty and doggie gets tired.* Doggie and kitty are in a race. Doggie chases kitty and doggie becomes tired (puffing and sweating). CLIP 2 (TARGET) *Doggie chases kitten and kitty gets tired.* Doggie and kitty are in a race. Doggie chases kitty and kitty becomes tired (puffing and sweating).

	CLIP 3 (TARGET) *Kitty chases doggie and kitty gets tired.* Doggie and kitty are in a race. Kitty chases doggie and kitty becomes tired (puffing and sweating).
10. Tiger **beat-be.frightened** wolf.	CLIP 1 (TARGET) *Tiger beats wolf and wolf gets frightened.* Tiger and wolf are quarreling. Tiger becomes angry and uses a big stick to beat wolf. Wolf gets frightened (trembles). CLIP 2 (TARGET) *Tiger beats wolf and tiger gets frightened.* Tiger and wolf are quarreling. Tiger becomes angry and uses a big stick to beat wolf. But wolf is too strong and the stick breaks after it hits him. Tiger gets frightened (trembles). CLIP 3 (TARGET) *Wolf beats tiger and wolf gets frightened.* Tiger and wolf are quarreling. Wolf becomes angry and uses a big stick to beat tiger. But tiger is too strong and the stick breaks after it hits him. Wolf gets frightened (trembles).

Control items (3 in each test block)		
BLOCK 1	1. Bear drinking water	(*"Yes"* answer called for)
	2. Rabbit running	(*"No"* answer called for)
	3. Cat sleeping	(*"No"* answer called for)
BLOCK 2	1. Rabbit eating a carrot	(*"Yes"* answer called for)
	2. Doggie walking	(*"No"* answer called for)
	3. Rabbit drinking water	(*"No"* answer called for)
BLOCK 3	1. Doggie jumping	(*"Yes"* answer called for)
	2. Bear drinking honey	(*"No"* answer called for)
	3. Snowman taking off hat	(*"No"* answer called for)

REFERENCES

Allen, S., Özyürek, A., Kita, S., Brown, B., Furman, R., Ishizuka, T., & Fujii, M. (2007). Language-specific and universal influences in children's syntactic packaging of Manner and Path: A comparison of English, Japanese, and Turkish. *Cognition*, 102, 16-48.

Ambridge, B., Pine, J. M., Rowland, C. F., & Young, C. R. (2008). The effect of verb semantic class and verb frequency (entrenchment) on children's and adults' graded judgements of argument-structure overgeneralization errors. *Cognition*, 106, 87-129.

Baayen, R. H. (2008). *Analyzing linguistic data: A practical introduction to statistics*. Cambridge, UK: Cambridge University Press.

Behrend, D. A. (1990). The development of verb concepts: Children's use of verbs to label familiar and novel events. *Child Development*, 61, 681-696.

Behrens, H. (1998). How difficult are complex verbs? Evidence from German, Dutch and English. *Linguistics*, 36, 679-712.

Bennis, H., den Dikken, M., Jordens, P., Powers, S., & Weissenborn, J. (1995). Picking up particles. In D. MacLaughlin & S. McEwen (Eds.), *Proceedings of the 19th Boston University Conference on Language Development* (pp. 70-81). Somerville, MA: Cascadilla Press.

Berman, R. A. (1985). The acquisition of Hebrew. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition* (Vol. 1, pp. 255-371). Hillsdale, NJ: Lawrence Erlbaum.

Berman, R. A. & Slobin, D. I. (Eds.). (1994). *Relating events in narrative: A crosslinguistic developmental study*. Hillsdale, NJ: Lawrence Erlbaum.

Bowerman, M. (1973). *Early syntactic development: A cross-linguistic study with special reference to Finnish*. Cambridge, UK: Cambridge University Press.

Bowerman, M. (1982a). Reorganizational processes in lexical and syntactic development. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 319-346). Cambridge, UK: Cambridge University Press.

Bowerman, M. (1982b). Starting to talk worse: Clues to language acquisition from children's late speech errors. In S. Strauss (Ed.), *U-shaped behavioral growth* (pp. 101-146). New York: Academic Press.

Bowerman, M. (1988a). The child's expression of meaning: Expanding relationships among lexicon, syntax, and morphology. In M. B. Franklin & S. S. Barten (Eds.), *Child language: A reader* (pp. 106-117). Oxford: Oxford University Press.

Bowerman, M. (1988b). Inducing the latent structure of language. In F. S. Kessel (Ed.), *The development of language and language researchers: Essays in honor of Roger Brown* (pp. 23-50). Hillsdale, NJ: Lawrence Erlbaum.

Bowerman, M. (1988c). The 'no negative evidence' problem: How do children avoid constructing an overly general grammar? In J. A. Hawkins (Ed.), *Explaining language universals* (pp. 73-96). New York: Basil Blackwell.

Bowerman, M. (1989). Learning a semantic system: What role do cognitive predispositions play? In M. Rice & R. Schiefelbusch (Eds.), *The teachability of language* (pp. 133-169). Baltimore, MD: Paul H. Brookes.

Bowerman, M. (1994). From universal to language-specific in early grammatical development. *Philosophical Transactions of the Royal Society of London B*, 346, 37-45.

Bowerman, M. (1996a). Argument structure and learnability: Is a solution in sight? In J. Johnson, M. L. Juge, & J. L. Moxley (Eds.), *Proceedings of the 22nd Annual Meeting* *of the Berkeley Linguistics Society* (pp. 454-468). Berkeley, CA: Berkeley Linguistics Society.

Bowerman, M. (1996b). Learning how to structure space for language: A crosslinguistic perspective. In P. Bloom, M. A. Peterson, L. Nadel, & M. F. Garrett (Eds.), *Language and space* (pp. 385-436). Cambridge, MA: MIT Press.

Bowerman, M. (2000). Where do children's word meanings come from? Rethinking the role of cognition in early semantic development. In L. P. Nucci, G. Saxe, & E. Turiel (Eds.), *Culture, thought, and development* (pp. 199-230). Mahwah, NJ: Lawrence Erlbaum.

Bowerman, M. (2005). Why can't you "open" a nut or "break" a cooked noodle? Learning covert object categories in action word meanings. In L. Gershkoff-Stowe & D. H. Rakison (Eds.), *Building object categories in developmental time* (pp. 209-244). Mahwah, NJ: Lawrence Erlbaum.

Bowerman, M. & Choi, S. (2001). Shaping meanings for language: Universal and language-specific in the acquisition of spatial semantic categories. In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 475-511). Cambridge, UK: Cambridge University Press.

Bowerman, M. & Choi, S. (2003). Space under construction: Language-specific spatial categorization in first language acquisition. In D. Gentner & S. Goldin-Meadow (Eds.), *Language in mind: Advances in the study of language and cognition* (pp. 387-482). Cambridge, MA: MIT Press.

Bowerman, M. & Croft, W. (2007). The acquisition of the English causative alternation. In M. Bowerman & P. Brown (Eds.), *Crosslinguistic perspectives on argument structure: Implications for learnability*. Hillsdale, NJ: Lawrence Erlbaum.

Bowerman, M., Majid, A., & Erkelens, M. (2003). Kids' "cut and break" clips. In N. Enfield (Ed.), *Field manual 2003* (pp. 96-102). Nijmegen: Language & Cognition Group, Max Planck Institute for Psycholinguistics.

Bowerman, M., Majid, A., Erkelens, M., Narasimhan, B., & Chen, J. (2004). Learning how to encode events of "cutting and breaking": A crosslinguistic study of semantic development. Poster presented at *The 32nd Child Language Research Forum*, Stanford, CA.

Braine, M. & Brooks, P. (1995). Verb argument structure and the problem of avoiding an overgeneral grammar. In M. Tomasello & W. Merriman (Eds.), *Beyond names for things: Young children's acquisition of verbs* (pp. 353-376). Hillsdale, NJ: Lawrence Erlbaum.

Broihier, K., Hyams, N., Johnson, K., Pesetsky, D., Poeppel, D., Schaeffer, J., & Wexler, K. (1994). The acquisition of the Germanic verb particle construction. Paper presented at *The 18th Boston University Conference on Language Development*. Boston, MA.

Brooks, P., Tomasello, M., Lewis, L., & Dodson, K. (1999). Children's overgeneralization of fixed transitivity verbs: The entrenchment hypothesis. *Child Development*, 70, 1325-1337.

Brown, P. (2001). Learning to talk about motion UP and DOWN in Tzeltal: Is there a language-specific bias for verb learning? In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 512-543). Cambridge, UK: Cambridge University Press.

Brown, R. (1973). *A first language: The early stages*. Cambridge, MA: Harvard University Press.

Brugman, C. (1988). *The syntax and semantics of HAVE and its complements.* Unpublished doctoral dissertation, University of California at Berkeley, Berkeley, CA.

Bybee, J. L. (1985). *Morphology: A study of the relation between meaning and form*. Amsterdam: John Benjamins.

Chao, Y.-R. (1968). *A grammar of spoken Chinese*. Berkeley, CA: University of California Press.

Chen, J. (2006). The acquisition of verb compounding in Mandarin. In E. V. Clark & B. F. Kelly (Eds.), *Constructions in acquisition* (pp. 111-136). Stanford, CA: CSLI.

Chen, J. (2007). “He cut-break the rope”: Encoding and categorizing “cutting and breaking” events in Mandarin. *Cognitive Linguistics*, 18, 273-285.

Chen, L. (2005). *The acquisition and use of motion event expressions in Chinese.* Unpublished doctoral dissertation, University of Louisiana, Lafayette, LA.

Cheng, L. L.-S. & Huang, C.-T. J. (1995). On the argument structure of resultative compounds. In M. Chen & O. Tzeng (Eds.), *In honor of William Wang: Interdisciplinary studies on language and language change* (pp. 187-221). Taipei: Pyramid Press.

Cheung, H.-T. (1992). *The acquisition of BA in Mandarin.* Unpublished doctoral dissertation, University of Kansas, Lawrence, KS.

Cheung, H.-T. (1998). Pingjun huayu changdu zai zhongwen de yingyong (The application of MLU measurement to Mandarin Chinese). *Ting Yu Hui Kan (Journal of Hearing Science)*, 13, 36-48.

Cheung, S.-L. (1998). Causative verbs in child Cantonese. In E. V. Clark (Ed.), *Proceedings of the 29th Annual Child Language Research Forum* (pp. 151-160). Stanford, CA: CSLI.

Choi, S. (1999). Early development of verb structures and caregiver input in Korean: Two case studies. *International Journal of Bilingualism*, 32, 241-265.

Choi, S. & Bowerman, M. (1991). Learning to express motion events in English and Korean: The influence of language-specific lexicalization patterns. *Cognition*, 41, 241-268.

Chomsky, N. (1959). Review of the book *Verbal Behavior* by B. F. Skinner. *Language*, 35, 26-58.

Chomsky, N. (1981). *Lectures on government and binding*. Berlin: Mouton de Gruyter.

Chomsky, N. & Lasnik, H. (1993). *Principles and parameters theory in syntax: An international handbook of contemporary research*. Berlin: Mouton de Gruyter.

Clark, E. V. (1981). Lexical innovations: How children learn to create new words. In W. Deutsch (Ed.), *The child's construction of language* (pp. 299-328). London: Academic Press.

Clark, E. V. (1982). The young word-maker: A case study of innovation in the child's lexicon. In E. Wanner & L. R. Gleitman (Eds.), *Language acquisition: The state of the art* (pp. 390-425). Cambridge, UK: Cambridge University Press.

Clark, E. V. (1993). *The lexicon in acquisition*. Cambridge, UK: Cambridge University Press.

Collins, C. (1997). Argument sharing in serial verb constructions. *Linguistic Inquiry*, 28, 461-497.

Croft, W. A. (2001). *Radical construction grammar: Syntactic theory in typological perspective*. Oxford, UK: Oxford University Press.

Cromer, R. (1974). The development of language and cognition: The cognition hypothesis. In B. Foss (Ed.), *New perspectives in child development* (pp. 184-253). Harmondsworth: Penguin.

de León, L. (2001). Finding the richest path: Language and cognition in the acquisition of verticality in Tzotzil (Mayan). In M. Bowerman & S. C. Levinson (Eds.), *Language acquisition and conceptual development* (pp. 544-565). Cambridge, UK: Cambridge University Press.

De Villiers, J. G. (1985). Learning how to use verbs: Lexical coding and the influence of the input. *Journal of Child Language*, 12, 587-595.
Dowty, D. (1979). *Word meaning and Montague grammar*. Dordrecht: Foris.
Erbaugh, M. (1978). Acquisition of temporal and aspectual distinctions in Mandarin. *Papers and Reports on Child Language Development*, 15, 30-37.
Erbaugh, M. (1982). *Coming to order: Natural selection and the origin of syntax in the Mandarin-speaking child.* Unpublished doctoral dissertation, University of California at Berkeley, Berkeley, CA.
Erbaugh, M. (1992). The acquisition of Mandarin. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition* (Vol. 3, pp. 373-455). Mahwah, NJ: Lawrence Erlbaum.
Erkelens, M. (2003). *The semantic organization of 'cut' and 'break' in Dutch: A developmental study.* Unpublished master's thesis, Free University of Amsterdam, Amsterdam, NL.
Fillmore, C. J., Kay, P., & O'Connor, M. C. (1988). Regularity and idiomaticity in grammatical constructions: The case of let alone. *Language*, 64, 501-538.
Gentner, D. (1978). On relational meaning: The acquisition of verb meaning. *Child Development*, 49, 988-998.
Gleitman, L. R. (1990). The structural sources of verb meanings. *Language Acquisition*, 1, 3-55.
Goldberg, A. E. (1991a). It can't go down the chimney up: Paths and the English resultative. In L. A. Sutton, C. Johnson, & R. Shields (Eds.), *Proceedings of the 17th Annual Meeting of the Berkeley Linguistics Society* (pp. 368-378). Berkeley, CA: Berkeley Linguistics Society.
Goldberg, A. E. (1991b). A semantic account of resultatives. *Linguistic Analysis*, 21, 66-98.
Goldberg, A. E. (1995). *Constructions: A construction grammar approach to argument structure*. Chicago, IL: University of Chicago Press.
Goldberg, A. E., Casenhiser, D. M., & Sethuraman, N. (2004). Learning argument structure generalizations. *Cognitive Linguistics*, 15, 289-316.
Goldstein, H. (2003). *Multilevel statistical models*. London: Hodder.
Green, G. (1972). Some observations on the syntax and semantics of instrumental verbs. In P. M. Peramteau, J. N. Levi, & G. C. Phares (Eds.), *Proceedings of the 8th Regional Meeting of the Chicago Linguistic Society* (pp. 83-97). Chicago, IL: University of Chicago.
Greenacre, M. J. (1984). *Theory and applications of correspondence analysis*. London, UK: Academic Press.
Gropen, J., Pinker, S., Hollander, M., & Goldberg, R. (1991). Affectedness and direct objects: The role of lexical semantics in the acquisition of verb argument structure. *Cognition*, 41, 153-195.
Gu, Y. (1992). *The syntax of resultative and causative compounds in Chinese.* Unpublished doctoral dissertation, Cornell University, Ithaca, NY.
Guerssel, M., Hale, K. L., Laughren, M., Levin, B., & White Eagle, J. (1985). A cross-linguistic study of transitivity alternations. In W. H. Eilfort, P. D. Kroeber, & K. L. Peterson (Eds.), *Papers from the Parasession on Causatives and Agentivity at the 21st Regional Meeting of the Chicago Linguistic Society* (pp. 48-63). Chicago, IL: Chicago Linguistic Society.
Haiman, J. (1985). *Iconicity in syntax*. Amsterdam: John Benjamins.
Hendriks, H. (1993). *Motion and location in children's narrative discourse: A developmental study of Chinese and Dutch.* Unpublished doctoral dissertation, University of Leiden.
Hendriks, H. (2005). Structuring space in discourse: A comparison of Chinese, English, French and German L1 and English, French and German L2 acquisition. In H.

Hendriks (Ed.), *The structure of learner varieties* (pp. 111-156). Berlin: Mouton de Gruyter.
Hickmann, M. (2003). *Children's discourse: Person, space and time across languages*. Cambridge, UK: Cambridge University Press.
Hickmann, M. & Hendriks, H. (2005). Children's expression of caused motion in French and English*,* Paper presented at *The 10th Conference of the International Association for the Study of Child Language*. Berlin, Germany.
Huang, C.-T. J. (1982). *Logical relations in Chinese and the theory of grammar.* Unpublished doctoral dissertation, MIT, Cambridge, MA.
Huang, C.-T. J. (2006). *Resultatives and unaccusatives: A parametric view*. Unpublished manuscript.
Jiang, S.-Y. (1999). Hanyu dongjieshi chanshend de shidai (The time of the emergence of Chinese resultatives). *Guoxue Yanjiu (Journal of the Study of Chinese)*, 6, 240-262.
Johnston, J. R. & Slobin, D. I. (1979). The development of locative expressions in English, Italian, Serbo-Croatian and Turkish. *Journal of Child Language*, 6, 529-545.
Kang, J. (1999). *The composition of the perfective aspect in Mandarin Chinese.* Unpublished doctoral dissertation, Boston University, Boston, MA.
Kang, J. (2001). Perfective aspect particles or telic Aktionsart markers? Studies of the directional verb compounds. *Journal of Chinese Linguistics*, 29, 281-339.
Levin, B. (1993). *English verb classes and alternations*. Chicago, IL: University of Chicago Press.
Levin, B. & Rappaport Hovav, M. (1995). *Unaccusativity: At the syntax-lexical semantics interface*. Cambridge, MA: MIT Press.
Levin, B. & Rappaport Hovav, M. (1998). *Resultatives: An event structure perspective*. Unpublished manuscript.
Li, C. & Thompson, S. A. (1981). *Mandarin Chinese: A functional reference grammar*. Berkeley, CA: University of California Press.
Li, D.-Y. (2003). *Causative and resultative constructions in Mandarin Chinese: A multiperspectival approach.* Unpublished doctoral dissertation, Göteborg University, Kompendiet, Sweden.
Li, F.-X. (1993). *A diachronic study of V-V compounds in Chinese.* Unpublished doctoral dissertation, State University of New York, Buffalo, NY.
Li, Y.-F. (1990). On V-V compounds in Mandarin. *Natural Language and Linguistic Theory*, 8, 177-207.
Li, Y.-F. (1995). Thematic hierarchy and causativity. *Natural Language and Linguistic Theory*, 13, 255-282.
Lieven, E. V. M., Pine, J. M., & Baldwin, G. (1997). Lexically-based learning and early grammatical development. *Journal of Child Language*, 24, 187-220.
Lu, J. H.-T. (1977). Resultative verb compounds vs. directional verb compounds in Mandarin. *Journal of Chinese Linguistics*, 5, 276-313.
Ma, Z. & Lu, J.-M. (1997). Xingrongci zuo buyu qingkuang kaocha (A study of adjectival complements in Mandarin Chinese). *Hanyu Yanjiu (Chinese Studies)*, 97, 3-9.
MacWhinney, B. (2000). *The CHILDES project: Tools for analyzing talk* (3rd ed.). Mahwah, NJ: Lawrence Erlbaum.
Majid, A., Bowerman, M., van Staden, M., & Boster, J. S. (2007). The semantics of "cutting and breaking" events: A crosslinguistic perspective. *Cognitive Linguistics*, 18, 133-152.
Majid, A., van Staden, M., Boster, J. S., & Bowerman, M. (2004). Event categorization: A crosslinguistic perspective. In K. Forbus, D. Gentner, & T. Regier (Eds.), *Proceedings*

of the 26th Annual Meeting of the Cognitive Science Society (pp. 885-890). Mahwah, NJ: Erlbaum.

Mayer, M. (1969). *Frog, where are you?* New York: Dial Press.

McClure, K., Pine, J. M., & Lieven, E. V. M. (2006). Investigating the abstractness of children's early knowledge of argument structure. *Journal of Child Language*, 33, 693-720.

McDonald, E. (1995). Completive verb compounds in modern Chinese: A new look at an old problem. *Journal of Chinese Linguistics*, 22, 317-362.

Min, R.-F. (1994). *The acquisition of referring expressions by young Chinese children: A longitudinal study of the forms and functions of early noun phrases.* Unpublished doctoral dissertation, Catholic University of Nijmegen, Nijmegen, NL.

Miyoshi, N. (1999). Compounds and complex predicates: Japanese evidence for a 'global' parameter. In A. Greenhill, H. Littlefield, & C. Tano (Eds.), *Proceedings of the 23rd Boston University Conference on Language Development* (pp. 453-461). Somerville, MA: Cascadilla Press.

Naigles, L. R. & Hoff-Ginsberg, E. (1998). Why are some verbs learned before other verbs? Effects of input frequency and structure on children's early verb use. *Journal of Child Language*, 25, 95-120.

Packard, J. L. (2000). *The morphology of Chinese: A linguistic and cognitive approach*. Cambridge, UK: Cambridge University Press.

Pederson, E. (2007). Event realization in Tamil. In M. Bowerman & P. Brown (Eds.), *Crosslinguistic perspectives on argument structure: Implications for learnability* (pp. 331-355). Mahwah, NJ: Lawrence Erlbaum.

Peyraube, A. (2006). Motion events in Chinese: A diachronic study of directional complements. In M. Hickmann & S. Robert (Eds.), *Space in languages: Linguistic systems and cognitive categories* (pp. 121-135). Amsterdam: John Benjamins.

Piaget, J. (1954). *The construction of reality in the child* (1937, 1st ed.). New York: Basic Books.

Piaget, J. (1971). *Biology and knowledge*. Chicago, IL: University of Chicago Press.

Pine, J. M., Ambridge, B., & Rowland, C. F. (2007). The no-negative-evidence problem and the retreat from (dative) overgeneralization errors: Children's and adults' sensitivity to verb frequency, verb semantics and morphological constraints. Paper presented at *The 32nd Boston University Conference on Language Development*. Boston, MA.

Pinker, S. (1984). *Language learnability and language development*. Cambridge, MA: Harvard University Press.

Pinker, S. (1989). *Learnability and cognition: The acquisition of argument structure*. Cambridge, MA: MIT Press.

Pye, C. (1994). *Breaking concepts: Constraining predicate argument structure*. Unpublished manuscript.

Pye, C. & Loeb, D. F. (1998). *Experimenting with the causative alternation*. Unpublished manuscript.

Pye, C., Loeb, D. F., & Pao, Y.-Y. (1996). The acquisition of breaking and cutting. In E. V. Clark (Ed.), *Proceedings of the 27th Annual Child Language Research Forum* (pp. 227-236). Stanford, CA: CSLI.

Roeper, T. & Williams, E. (Eds.). (1987). *Parameter-setting and language acquisition*. Dordrecht: Reidel.

Schaefer, R. P. (1979). Child and adult verb categories. *Kansas Working Papers in Linguistics*, 4, 61-76.

Shen, L. (1993). Guanyu hanyu jieguo fuhe dongci zhong canxiang jiegou de wenti (On the argument structure of Mandarin resultative verb compounds). *Yuwen Yanjiu (Linguistic Studies)*, 48, 12-21.

Simpson, J. (1983). Resultatives. In B. Levin & M. Rappaport Hovav (Eds.), *Papers in lexical-functional grammar* (pp. 143-157). Bloomington, Indiana: Indiana University Linguistics Club.

Slobin, D. I. (1970). Universals of grammatical development in children. In G. B. F. d'Arcais & W. J. M. Levelt (Eds.), *Advances in psycholinguistics* (pp. 174-186). Amsterdam: North-Holland.

Slobin, D. I. (1973). Cognitive prerequisites for the development of grammar. In C. A. Ferguson & D. I. Slobin (Eds.), *Studies of child language development* (pp. 175-208). New York: Holt, Rinehart and Winston.

Slobin, D. I. (1985). Crosslinguistic evidence for the Language-Making Capacity. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition* (Vol. 2: *Theoretical issues*, pp. 1157-1256). Hillsdale, NJ: Lawrence Erlbaum.

Slobin, D. I. (1996). From "thought and language" to "thinking for speaking". In J. J. Gumperz & S. C. Levinson (Eds.), *Rethinking linguistic relativity* (pp. 70-96). Cambridge, UK: Cambridge University Press.

Slobin, D. I. (1997a). The origins of grammaticizable notions: Beyond the individual mind. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition* (Vol. 5: *Expanding the contexts*, pp. 265-323). Mahwah, NJ: Lawrence Erlbaum.

Slobin, D. I. (1997b). The universal, the typological, and the particular in acquisition. In D. I. Slobin (Ed.), *The crosslinguistic study of language acquisition.* (Vol. 5: *Expanding the contexts*, pp. 1-39). Hillsdale, NJ: Lawrence Erlbaum.

Slobin, D. I. (2000). Verbalized events: A dynamic approach to linguistic relativity and determinism. In S. Niemeier & R. Dirven (Eds.), *Evidence for linguistic relativity* (pp. 107-138). Amsterdam: John Benjamins.

Slobin, D. I. (2004). The many ways to search for a frog: Linguistic typology and the expression of motion events. In S. Stromqvist & L. Verhoeven (Eds.), *Relating events in narrative: Typological and contextual perspectives* (pp. 219-257). Mahwah, NJ: Lawrence Erlbaum.

Smith, C. (1990). Event types in Mandarin. *Linguistics*, 28, 309- 338.

Smith, C. (1991). *The parameters of aspect*. Dordrecht: Kluwer.

Snyder, W. (1995). *Language acquisition and language attrition: The role of morphology.* Unpublished doctoral dissertation, MIT, Cambridge, MA.

Snyder, W. (2001). On the nature of syntactic variation: Evidence from complex predicates and complex word-formation. *Language*, 77, 324-342.

Stromswold, K. & Snyder, W. (1997). The structure and acquisition of English dative constructions. *Linguistic Inquiry*, 28, 281-317.

Sun, C. & Givón, T. (1985). On the so-called SOV word order in Chinese: A quantified text study and its implications. *Language*, 61, 329-351.

Sybesma, R. (1999). *The Mandarin VP*. Dordrecht: Kluwer.

Tai, J. H.-Y. (1984). Verbs and times in Mandarin Chinese: Vendler's four categories. In D. Testen, V. Mishra, & J. Drogo (Eds.), *Papers from the Parasession on Lexical Semantics of the 20th Regional Meeting of the Chicago Linguistic Society* (pp. 289-296). Chicago, IL: Chicago Linguistic Society.

Talmy, L. (1985). Lexicalization patterns: Semantic structure in lexical forms. In T. Shopen (Ed.), *Language typology and syntactic description* (Vol. 3: *Grammatical categories and the lexicon*, pp. 36-149). Cambridge, UK: Cambridge University Press.

Talmy, L. (1991). Path to realization via aspect and result. In L. A. Sutton, C. Johnson, & R. Shields (Eds.), *Proceedings of the 17th Annual Meeting of the Berkeley Linguistics Society* (pp. 480-519). Berkeley, CA: Berkeley Linguistics Society.

Talmy, L. (2000). Chapter 3: A typology of event integration. In *Toward a cognitive semantics* (Vol. II*: Typology and process in concept structuring*, pp. 213-288). Cambridge, MA: MIT Press.

Tardif, T. (1993). *Adult-to-child speech and language acquisition in Mandarin Chinese.* Unpublished doctoral dissertation, Yale University, New Haven, CT.

Tardif, T. (1996). Nouns are not always learned before verbs: Evidence from Mandarin speakers' early vocabularies. *Developmental Psychology*, 32, 492-504.

Tenny, C. L. (1987). *Grammaticalizing aspect and affectedness.* Unpublished doctoral dissertation, MIT, Cambridge, MA.

Theakston, A. L. (2003). The role of entrenchment in children's and adults' performance on grammaticality judgment tasks. *Cognitive Development*, 19, 15-34.

Tomasello, M. (1992). *First Verbs: A case study of early grammatical development*. Cambridge, UK: Cambridge University Press.

Tomasello, M. (2000a). First steps toward a usage-based theory of language acquisition. *Cognitive Linguistics*, 11, 61-82.

Tomasello, M. (2000b). A usage-based approach to child language acquisition. In J. Good & A. Yu (Eds), *Proceedings of the 26th Annual Meeting of the Berkeley Linguistics Society* (pp. 305-320). Berkeley, CA: Berkeley Linguistics Society.

Tomasello, M. & Brooks, P. (1998). Young children's earliest transitive and intransitive constructions. *Cognitive Linguistics*, 9, 379-395.

Tsao, F.-F. (1996). On verb classification in Chinese. *Journal of Chinese Linguistics*, 24, 138-191.

Uehara, S., Li, Q.-M., & Thepkanjana, K. (2001). A contrastive study of resultative constructions in Japanese, Korean and Mandarin Chinese: A cognitive approach. *Proceedings of the 1st Seoul International Conference on Discourse and Cognitive Linguistics: Perspectives for the 21st Century* (pp. 292-304). Seoul, Korea: Yonsei University.

Venables, W. N. & Smith, D. M. (2002). *An introduction to R*. Bristol, UK: Network Theory.

Wang, L. (1954). *Zhongguo yufa lilun (Theories of Chinese syntax)*. Shanghai: Commercial Press.

Whorf, B. (1956). *Language, thought, and reality: Selected writings*. Cambridge, MA: MIT Press.

Wittek, A. (1999). *"... and the prince woke Sleeping Beauty again." Learning the meaning of change-of-state verbs: A case study of German.* Unpublished doctoral dissertation, University of Tübingen, Germany.

Wittek, A. (2002). *Learning the meaning of change-of-state verbs: A case study of German child language*. Berlin: Mouton de Gruyter.

Wittek, A. & Tomasello, M. (2002). German children's productivity with tense morphology: The *Perfekt* (present perfect). *Journal of Child Language*, 29, 567-589.

Xiao, R. & McEnery, A. (2004). *Aspect in Chinese: A corpus-based study*. Amsterdam: John Benjamins.

Zou, K. (1994). Directional verb compounds in Chinese. In K. Beals, J. Denton, R. Knippen, L. Melnar, H. Suzuki, & E. Zeinfeld (Eds.), *Proceedings of the 30th Regional Meeting of the Chicago Linguistic Society* (pp. 443-457). Chicago, IL: Chicago Linguistic Society.